JOURNAL
OF
THE MILITARY SERVICE INSTITUTION
OF THE
UNITED STATES.

"I cannot help plead to my countrymen, at every opportunity, to cherish all that is manly and noble in the military profession, because Peace is enervating and no man is wise enough to foretell when soldiers may be in demand again."—SHERMAN.

VOL. XXIV. JANUARY, 1899. NO. XCVII.

USES OF MACHINE GUNS.

BY FIRST LIEUT. JOHN H. PARKER, 13TH U. S. INFANTRY,
LATE COMMANDING MACHINE GUNS 5TH CORPS.

THE machine-gun problem, like all others, must be solved by original work. It does no good to compile the views of theorists; the student must think it out for himself. He must be thoroughly acquainted with the capacity, mechanism and possibilities of his weapon, and willing to stake his professional life on the results of his work. He must have to the highest degree what Professor Bass calls the "courage of his convictions." Such a man will find the opportunity if one exists; no other man will succeed anyhow.

There no longer exists a question as to the power and serviceability of the weapon, either on the offensive or defensive. These things are now as definitely settled in regard to machine guns as in regard to any other arm of the service. The uses of the arm were abundantly illustrated in the Santiago campaign. and a month afterward in the Soudan.

The tactical employment of the guns will be first outlined, illustrating from actual use, then the present systems of organization, from which we will proceed to deduce the proper organization to develop the full power of the new arm.

OFFENSIVE USES.

These have been demonstrated on reconnoissance, as advance guard and on the battle-field. The weapon does not take the

place of infantry nor of artillery nor of any other arm of the service. It may be used to give a reserve strength to the antennæ which an army sends out to feel its way into the enemy's country. A machine gun company may be used alone or as part of an advance guard composed of infantry, of infantry and cavalry combined, or of all arms of the service. In taking this position it will be observed that it is assumed that the mobility of the new arm is as great as that of cavalry. This was not true a few months ago, but in the last few months improvements in the carriage for machine guns have been devised which put the question of mobility beyond being an issue in the future. These improvements are such as to make it equally possible to move the guns by draft, by pack mule, or by hand. They have been so far perfected that there is no longer a doubt of their success. This improvement opens a new field of usefulness to the new arm, as an auxiliary to cavalry expeditions. Indeed, at Santiago, the guns, even as mounted, proved to be sufficiently mobile for all the purposes of that campaign.

On the advance to the front at Santiago, which was practically advance guard work and was conducted in the same manner, the machine guns were used alone. The company of four pieces had to march 17 miles through hostile country, where the presence of the enemy on one flank was known, and suspected on the other. It had to move in column of pieces along a narrow trail where there were innumerable opportunities for surprise and ambush. The services of a cavalry escort were offered and were declined, because it was desired to give an object lesson in every possible way of the power of the arm.

The crew of the third piece was told off as feelers. They pushed out rapidly to the front and reconnoitred every side path and hill near the road. The orders were on encountering the enemy to open magazine rifle fire from scattered positions, hold the enemy for four or five minutes if possible, and then withdraw, apparently in flight, giving gangway for the pieces. They were to halt abreast, take cover as skirmishers, and support the pieces, keeping careful watch to the flanks. The orders to the pieces were for the two leading ones to form battery to the front, covered as much as possible by the undergrowth, and to wait commands before firing. The fourth piece was to form

battery to the rear, ready to fire to either flank. It was earnestly desired to try this combination, and believed that the four guns could hold their own against as many regiments.

The only change in this idea, if with infantry, would be a larger force of feelers. If with infantry and cavalry combined, the cavalry should be thrown well out in front of the feelers, should retire precipitately, and form under the best cover obtainable in rear for their charge. If the enemy pursues, as he is almost sure to do, when he feels the weight of the machine-gun fire he is sure to become more or less demoralized, and, at the opportune moment, will be an easy mark for a rapid counter attack by cavalry.

This idea involves all the elements of a surprise, or an ambush. If the enemy falls into the trap he will be inevitably beaten, and will lose heavily. There is no such thing as a successful attack by infantry or cavalry or by both combined against machine guns well handled. There is no chance for artillery, if the machine guns once get within range, and have a plentiful supply of ammunition. There was always a plentiful supply at Santiago—but it may be remarked, in passing, that the Gatlings at Santiago used a little less than 50,000 rounds, all told, including the battle and the siege. This effectually disposes of the old song that machine guns are wasteful and extravagant with ammunition. Machine guns will waste ammunition unless they are judiciously handled, but so will infantry or cavalry, and it is much easier to regulate the expenditure of ammunition in the case of machine guns than in the case of either of the two arms mentioned. The Gatlings there, instead of being a menace to the ammunition supply of the army, were the means by which it was supplied to a large part of the firing line. Thousands of rounds were hauled by the Gatling limbers and distributed right on the firing line, insuring a plentiful supply to all the troops in their neighborhood. Among the troops for whom it was thus hauled were the Third, Ninth, and Tenth Regular Cavalry and the famous "Rough Riders."

If the enemy fails to pursue he must be attacked. The feelers were in that case to edge cautiously forward on new ground, keeping concealed as much as possible, and develop the position of the enemy by reconnoissance. The guns were then

to be brought up to the most favorable position, and were to open at once with full force. If the enemy be not intrenched he must retire; if he be intrenched the pieces must either retire successively, or hold the ground for infantry to complete the assault. The question as to which should be done was to be determined by the circumstances of the case. In the general case the guns would hold their position, unless the enemy was in very heavy force, and was aided by a strong artillery force.

It is much regretted that no opportunity was presented to try these tactics, but no doubt is entertained that the plan would have been perfectly successful. Officers have offered the criticism that the work cut out for this little four-gun company in this plan was beyond its powers. The reply is that the critics said before the battle that the guns could not be used in battle on the offensive. The foregoing views were filed in the office of the Adjutant General, January 1, 1898, together with a discussion of the proper use of the guns in battle, and when the occasion came the views were fully demonstrated on the battle-field to the full extent of the opportunity. It is claimed that *all* the views then advanced were correct, and that these are equally so. Certainly they are worthy of more careful consideration than they have heretofore been given by the text writers.

The offensive value of the weapon in battle is very great. It can be put in at the critical moment and its fire is decisive. This has been demonstrated in actual battle. Wherever infantry can go machine guns can go; wherever ammunition can reach infantry it can reach the guns. The cover their fire gives to infantry enables it to make the final assault with little loss, while covering the intervening space, because the fire of the machine guns is so withering that no troops can live, within range, to oppose it. Even when they are intrenched the machine-gun fire drives them to the bottom of the ditch and almost instantly compels them to stop firing. Each machine gun can cover in this manner, effectively, about 250 yards of the enemy's intrenchments.

The machine gun is its own range finder. It is not a long-range weapon, except in one particular, to be noted later. It has all the limitations of the rifle in this respect. It is pointed exactly as one points a garden hose. The effect of its

fire is so plainly perceptible that the gunner needs no other indication. Oscillators are not needed, nor any mechanical device of a similar nature. A perfectly free manipulation of the line of fire is the vital requisite. Even sights are hardly necessary. The gunner seldom looks at them. His gaze is fixed upon the point he seeks to cover, while his hand manipulates the pointing lever. As he changes the elevation, gradually, he brings the objective within the cone of fire, upon which all animate life instantly disappears at that point. The gunner then sweeps to the right or left, correcting his elevation by the same means, from time to time. This is the precise manner in which machine guns were used on the skirmish line and in the trenches at Santiago, and the only use made of sights was to lay the gun upon such objects as a machine gun, belonging to the enemy, or a piece of artillery in a gun-pit. In these cases, the ranges having been previously determined, the Gatling guns were laid with the utmost precision and clamped.

The one long-range use of machine-gun fire, referred to, is that of vertical fire at distances exceeding 2500 yards, or at objects behind a hill, not visible on account of the terrain. Fire of this kind was so successfully used at Santiago, that General Toral specifically mentions it in his report, stating that it rendered the streets unsafe, struck terror to the hearts of the inhabitants, and was one of the contributing causes of the surrender. In this case, the Gatling gun was simply pointed at a sufficiently high angle, based upon a knowledge of its trajectory, to insure that the bullets would fall in the city; the line of fire was then shifted, from point to point, by hand at convenience, thoroughly sweeping all that part of the city not visible to the gunner, with a most galling vertical fire. The idea was borrowed from the use made of the same kind of fire by the Turks at Plevna. In this case no sights were needed on the gun at all. A gunner's quadrant, roughly constructed, was the only appliance used.

To cover the successful charge at San Juan Hill, Santiago, the company was brought up to a point about a hundred yards back of where its presence would be detected by the enemy. This point was determined by personal reconnoissance under fire. The battery was held at its place, under fire, while the

troops, covered to a slight extent by badly directed and inefficient artillery fire from the 2000 yards point, were pushed forward and deployed along the bank of the creek. The machine-gun crews lay down under their guns, and the pieces were stubbornly held there until a sufficient force had been deployed to assault the hill.

The machine gun is preëminently an emergency weapon. It is the ideal arm for fleeting opportunities. Up to this time it had been supposed, based upon the reiterated statements of text-writers, that such guns were good for only a few minutes' work, that they soon would become overheated, or get out of ammunition. There were only 9600 rounds per gun at hand, and it was determined to use this at the time when it would do the most good. Once it was thought this moment had arrived, and the guns were started forward, but they were stopped by a staff officer, with the information that the deployment was not yet completed. The successful captain of a machine-gun company must keep cool, keep his men in hand and bide his time. He must have a clear head, and must know something of the commander's plans. This information had been given.

The deployment continued, under a savage fire of Mausers, covered by an equally savage fire from our own line, and was at length completed. There was over a mile of solid rifle fire on each side, at the short range of six to eight hundred yards. The enemy was well intrenched. He did not yield nor slacken fire. His troops were veteran soldiers, survivors of a hundred fights. It was all that our troops could do to hold their positions. Some of them were compelled to fall back, notably the Sixth Infantry.

Just at this moment, the machine guns dashed forward at a gallop, a hundred yards beyond the skirmishers, and instantly opened with three guns at 800 shots each, per minute. One gun was laid on the San Juan block house, the other two swept back and forth on the trenches along the hill. There was no occasion for range finders. The actions of the enemy afforded all the indications that were necessary as to accuracy of fire. Whenever the right elevation was obtained he simply disappeared from the place at which the piece was pointed. The fire was then made to sweep back and forth along the crest, eleva-

tion being corrected from time to time in the same manner. This storm of fire made itself felt instantly, and produced a lull in the returned fire within two minutes. Taking advantage of this lull, the line swept forward in the charge, losing very few men while covering an open space of 600 yards. The machine guns created a canopy of bullets over their heads, under which they ran forward in comparative safety. Just before our line reached the military crest, the guns ceased firing, and their crews witnessed the most thrilling spectacle since the capture of Lookout Mountain, the crowning of the crest by a straggling line of dark blue, and the unfurling of our flag over the captured hill.

Here ended the offensive use of machine guns at Santiago. It was short but glorious, and it completely settled the question as to the power and usefulness of machine guns in battle. It was the first time that such guns had ever been so used, but will not be the last. *This eight and one-half minutes marked an epoch in the tactics of the battle-field, and created a new arm of the service.*

At Omdurman, a month later, machine guns again played an important part. Their first use in that battle was on the defensive. The solid British lines were charged repeatedly by the fanatical Dervishes, who came on in irregular masses. They never made contact, because the fire of the automatic Maxim guns was too deadly. After breaking the strength of the Dervish assault, Kitchener made a counter-assault, and the Maxims were brought into play in a telling manner on the offensive. Their fire is described, in both cases, by an eye-witness, as having been simply murderous. But this was in savage warfare. The tactics of the enemy were entirely favorable to the use of machine guns, and the range was pistol-shot. At Santiago our opponents were civilized, trained soldiers, and veterans, in intrenchments.

Whether the machine guns could have been used at Santiago at long range, to cover the deployment, was not settled. There was artillery for that purpose, and it was believed the machine guns would be more useful for the function they finally performed. There were only four machine guns, and not enough ammunition at hand to attempt both problems. The total

amount of ammunition consumed in this first action, covering the charge, was less than 20,000 rounds. This was an absurdly small amount considering the character of the work performed and there was enough left in the limber chests to justify pushing the pieces forward to the skirmish line on the captured hill.

This may be viewed either as a defensive or as an offensive movement. If the fleeing enemy was to be vigorously pressed it would be part of the offensive movement, and the guns would repeat from the top of the San Juan Hill what they had already accomplished in the charge to capture it. If the charge had been continued the guns would have proved a powerful auxiliary, and would have covered the charging line with a hissing canopy of steel as they had done before. If the assault was not to be pressed, and should the enemy make a counter-attack, the guns would be at the best place to develop that defensive power which has always been conceded to be a characteristic of the machine gun. It proved that the troops were too much exhausted to continue the assault. The guns were therefore placed on the skirmish line and were used vigorously for about half an hour to give the troops a chance to rest somewhat. Well it was that this was done, as the history of the rest of that battle shows.

The battle then lulled, after which, at about 4 o'clock P. M., the enemy made a desperate counter-assault. He formed up with precision of veterans, and charged up to the military crest of the hill on the Santiago side. Colonel Roosevelt says of this: "As the afternoon wore on the Spaniards became bolder, and made an attack on the position. They did not push it home, but they did advance, their firing being redoubled. We at once ran forward to the crest and opened on them, and, as we did so, the unmistakable drumming of the Gatlings opened abreast of us, to our right, and the men cheered again. As soon as the attack was definitely repulsed, I strolled over to find out about the Gatlings, and there I found Lieutenant Parker with two of his guns, right on our left, abreast our men, who were at that time closer to the Spaniards than any others." The explanation of the seeming discrepancy between "right" and "left" as the colonel gives the story, is that there was one Gatling on his right, abreast his men, and two more on his left, also on the

skirmish line abreast his men. Owing to the shape of the line, those on his left were able to flank the ground in his front. When the attack he speaks of was made the gun on his right struck the advancing enemy squarely in front, and one of those on the left was used to enfilade the advancing line of Spaniards. Captain Marcotte had an interview with a Spanish officer who was in this attack, and who stated that out of 600 troops engaged in it only 40 ever returned to Santiago. As no prisoners were taken, the remainder must have been killed there. Perhaps this will serve to explain, partially, why "they did not push it home." The results of this fire, aided by that of the infantry and cavalry on the hill, were murderous beyond description.

The use of machine guns on the defensive has been so generally conceded that a mere reference to the fact that the theories heretofore advanced were fully demonstrated is sufficient. There was one important particular, however, in which the example departed from theory. Book soldiers have always contended that machine guns were useless except behind defenses. These guns had not only been used in the open to cover the charge, a function heretofore considered impossible by the writers, but were at this time used in the open on the skirmish line on the defensive to repel a counter-charge, which advanced to within two hundred yards of our position. In this case, as at Omdurman, the enemy was unable to make contact. It may be that the troops would have held this hill without the machine guns, but it was the almost unanimous opinion at the time, and on the ground, of the officers and men composing the firing line on the hill, that they never could have sustained themselves without the aid given by the machine guns. The guns were put right in among the skirmishers, who were hugging the ground for cover, and the crews stood boldly up to their work, covered only by the screen made by their own bullets. The best shield is a well-directed fire upon the enemy. The machine guns did not lose a man during the defensive use of the guns.

The defense of a position and the uses of machine guns in siege operations were subsequently exemplified. The wheels were taken off and the guns placed in the trench among the soldiers. Nothing showed except the muzzles, and these were

visible only a short distance. Two Colt's automatic guns had been added to the company, which were mounted upon tripods in the trench, and the dynamite gun had been directed to coöperate tactically with the battery thus formed. The gunners were alert to take advantage of every exposure by the enemy, and the dynamite gun was used to induce these exposures.

This gun has not been perfected enough to insure accuracy of fire, but it was possible to drop four and a half pounds of explosive gelatine somewhere within a radius of say, two hundred yards of the object aimed at. The explosion of this projectile was always followed by exposures of the enemy, greater or less, depending upon how close the charge fell. This gave the coveted opportunity for machine guns, and this operation was successfully tried thirteen times. Too much praise cannot be given to Captain Borrowe, for the cool and intrepid manner in which he performed this work. He had an experimental piece, and was handling high explosives under fire, but he was as cool as if there had been only boxes of sawdust a thousand miles from danger. Occasionally, though only by luck, a charge would fall near enough to its target to do effective work of demolition. In one case a battery of two 3-inch guns was wiped out of existence by a lucky shot.

The defensive uses of machine guns on outpost duty were also illustrated. There was a road on which a Cossack post was established, well out toward the enemy's lines. A slight trench was dug, in which the members of the post lay hidden, while a single man was ensconced as a sentinel in a small pit about forty yards to the front. A Gatling was used by this outpost at night, being taken quietly after dark to a point about fifty yards in rear of the post. It was there placed so that its azimuth motion swept thirty degrees to each side of the road. The piece was concealed by the undergrowth, and only one member of the crew was kept awake at a time. The orders were that upon the approach of the enemy in force, the Cossack post was to withdraw and give a prearranged signal to the Gatling gun. The piece was returned each morning, just before daylight, to a position on the hill at which it could be used effectively upon the enemy's trenches. It thus performed double duty. While

in support of the Cossack post at night, it was on ground about twenty feet lower than the American trenches in its rear, and was to be worked to its limit if called upon, regardless of all fire from either side.

The use of machine guns for rear-guard duty was not demonstrated, because there never was a rear guard in the Fifth Corps. This use of the arm has been so fully discussed, that its theory is generally well understood. Its value in this service can hardly be overestimated, and depends upon the tremendous power of its concentrated fire, its ease of withdrawal and concealment. These qualities endow the arm with splendid adaptability for ambushes, surprises and stratagems. The power of a sharp counter-stroke and speedy retreat belong preëminently to this arm of the service.

One other function of the arm was not demonstrated—its typical action with mounted cavalry. Enough was shown, however, to prove that the arm as organized at Santiago, has a mobility far superior to that of light artillery, on account of the superior lightness of its pieces, and that it can easily keep up with cavalry. It will therefore, in the future, perform all the functions of mounted infantry, and many of the functions of horse artillery. It is far preferable to the latter for cavalry service, as it can do things utterly impossible for that arm.

The one fact demonstrated more clearly than all others is that machine guns can live in positions utterly untenable for any kind of artillery. This was shown by the withdrawal of the combined batteries of Best and Parkhurst on the morning of July 2d, from ground held successfully by the Gatlings all the previous afternoon under well-directed artillery fire from the enemy, and against two counter-charges. No disparagement of the infantry and cavalry is intended. Best and Parkhurst had exactly the same support the machine guns had in this respect, so that part of the question can be left entirely out of consideration. The artillery, having had several hours to dig gun-pits, fired only three rounds, and was compelled to seek safety in precipitate and disorderly flight. The machine guns had not only remained on the same ground all the previous afternoon, but held their place on the infantry's most advanced line until the surrender, and never even thought of retiring.

Whenever they opened up they made themselves felt at once; they put out of action the battery that had driven Best and Parkhurst away, and kept it out of action until the surrender, in addition to giving substantial aid in holding down the enemy's trench fire.

This superiority of the machine guns at short ranges is due to two elements. 1st. It presents a smaller target, draws less fire from the enemy, can be more easily and more quickly covered by earthworks. 2d. Its fire is more destructive than that of an equal number of pieces of artillery of any calibre at short ranges.

These are demonstrated facts, and the reason is evident. The artillery seldom fires over a shot per gun per minute. At Santiago it did not fire oftener than a shot every five minutes per gun. Each shell bursts into about two hundred and seventy-three unaimed fragments. The artillery is not capable of a sweeping fire. The machine gun fires in a minute from 600 to 900 aimed shots. Moreover, the fire of machine guns is intelligibly and instantly dirigible. It seeks its target with the same ease one would point his finger at an object, can be swept along a trench or concentrated upon a point, and is guided accurately by the actions of the enemy. Nothing made of flesh and blood can live before it.

ORGANIZATION.

This arm has never been properly organized in any army. The experimental company at Santiago was the first one ever used that was even approximately right.

Three theories of organization for machine guns have been advocated:

1. The theory that it is part of the artillery. This was tried by the French and proved a dismal failure. The history of their blunder is familiar to all military students. In former times artillery has been known to perform machine gun functions upon the skirmish line with canister. But machine guns have never been known to perform a purely artillery function. The increased destructiveness and range of the modern small-arm makes it impossible in the general case for any arm which depends upon draft to be used upon the skir-

mish line, and for any arm which presents so large a target as that made by artillery to live at short ranges. This having been demonstrated upon the battle-field, from Gravelotte to Santiago, the theory of organizing machine guns as part of the artillery is exploded.

2. The use of machine guns as auxiliary attached fragments with tactical units of the other arms.

This is the organization adopted by the English service. It is defective in that it develops no *esprit du corps*, has no standard and no traditions. Its personnel is too variable and it does not develop expertly trained crews nor officers. In the English service it has been sometimes successful because of the great latitude allowed to commanders of machine-gun detachments. They are rarely trammelled by any orders except those given by General Shafter at Santiago, "Find the best place you can, and make the best use of your guns possible." This works well so long as the guns are handled by enthusiastic experts, but such can not be always the case. Accordingly we find much difference in the usefulness of machine guns in their service. Some guns are always in the way of their battalions and are never useful, others seem to be always just where they are wanted and come into the fight at the right place, in the very nick of time. The difference is in the officers, not in the guns.

This system was partially illustrated in our service at Santiago by the Colt's automatics. These guns were attached to a regiment, the Rough Riders, but were not made effective until they were made part of a machine-gun company organnized upon correct principles.

3. As a separate, independent arm of the service.

This was the organization given to the machine guns at Santiago. So far as independent action was concerned, they were ahead of any other organization in the army. They were recognized as a separate command and were on the same basis in regard to orders as an independent division. The results accomplished justify the system. "Nothing succeeds like success." When the Colt guns were attached to this organization they became at once effective. Before that they had been wandering about like orphans and had not fired a shot. The full power of the dynamite gun was not developed until it too became

attached for direction to the independent machine-gun corps. The theory that machine guns should form an independent arm was first advanced many years ago by Dr. Gatling, the inventor of the Gatling gun. It was first advocated by a military man, in 1886, by General Williston, of our service, in a very able article in THE JOURNAL OF THE MILITARY SERVICE INSTITUTION. General Williston's opinions being those of an able soldier and an expert artillerist, carry great weight. The next convert, among prominent military men, was Lord Wolseley, of the English service. In 1890, he strongly advocated the formation of an independent machine-gun corps for the British army. This idea remained in abeyance until the Santiago campaign, when it was acted upon for the first time by General Shafter. It is now so thoroughly demonstrated as to be axiomatic, and meets the approval of all trained soldiers in the world. This system has been adopted by at least two great powers since the first of July, and will soon force its way into all the great armies of the world.

The fact that we have three arms of the service, and have had three from time immemorial, does not preclude the development of a fourth arm. The training necessary for machine guns, the tactical uses of the weapon, and the tremendous possibilities for effective use of the guns, when well handled, require special study and special organization. The tactical unity of any existing arm of the service would be violated by adding machine guns to its equipment. This violation would impair the efficiency of any existing arm, and would prevent development of the full power of machine guns. The artillery has always disclaimed it, the infantry and cavalry are simply impossible for it. Hence it follows that a new arm must be organized, with its own personnel, its own traditions, and its own technical studies. It will be the *élite* arm of the service. To it will flock the adventurous spirits who should man such guns, and under wise administration by an expert in the machine-gun art, such a corps will become one of the most powerful arms of the service.

THE DEFENSE OF A FREE PEOPLE, IN THE LIGHT OF THE SPANISH WAR.

By Colonel H. M. BOIES, late 13th Regt. Penn. N. G.

OUR brief war with Spain is remarkable and unique among the conflicts between great nations in several of its grander and more important aspects, as well as in many of its minor details. The lessons of its experiences are quite as instructive, and ought to be as profitable, to the American statesman as to the military student. The latter observing the rapid promotions to responsible commands as well as the transfers of military commanders to high civil authority after conquest, the former taught again the fearful sorrow, suffering and cost caused by heedless neglect of proper preparation before the conflict, may both find in them inspiration and guidance to a higher plane of patriotic service.

This war is unique in respect to its cause. The horrors and "hell" of war were voluntarily undertaken for the relief of the sufferings of a neighboring people to whom we were under no other obligation except that of a common humanity and of neighborhood. Cause enough, indeed, but not hitherto heeded among the nations. The American people could no more turn a deaf ear to the despairing wail of Cuba than a strong man could neglect the cry of murder or fire from his neighbor's house.

This war is unique in that it was forced upon the rulers by the people, who were to suffer in it and do the fighting, instead of being forced upon the people by the rulers, as heretofore. It was distinctly our people's war, who threw themselves into the arena against a nation having military history and training and a trained army twelve times greater than our own, without the smallest preparation on our part.

It is unique in that its battles were fought and its victories won by "the men behind the guns," rather than the ability of our commanders, to an extent not heretofore known, as proudly acknowledged even by the chieftains of our navy, whose leadership is above criticism. Never since the days of the Pythian

phalanx and the Roman short sword have individual endurance, valor, and skill so decisively won the laurels of victory as at Manila and Santiago in these days of long range weapons of precision.

It is unique, moreover, because never before have military operations, in raising, equipping and sending forth armies, fighting battles, governing conquered territory, caring for the sick and wounded soldiers, in all their details, been subjected to such an intense search-light of public criticism by the indefatigable energies of so large and free a newspaper and magazine press as has made our entire people from Maine to California, to say nothing of the rest of the world, perfectly familiar with every phase and fault of them.

It is well that the people who made this war, who fought this war, and whose "withers have been wrung" in it so far beyond their deserts, should be thoroughly informed and impressed with its misfortunes and faults in order to recognize their own responsibility for them. It is unreasonable and idle to blame the brave and patriotic, but inexperienced, and often ignorant officers, who were suddenly called to new and great responsibilities, for faults and mistakes which experience alone can correct, or for the want of arms, ammunition, equipment and supplies, which the people who called them to arms should have provided. In the light of our military experiences in the six months following the call to arms it is almost appalling to consider what might have been our fate if we had been confronted by a really powerful nation.

The American people are accustomed to recognize and correct the mistakes which they make in self-government, and although the lessons of the Civil War were largely neglected on account of the national impoverishment which resulted from it until they lost their force, the signal and peculiarly impressive instruction of the Spanish war and its results must not pass unheeded, or we shall invite troubles which may be beyond our powers of endurance. The remedy for the ills from which we have suffered must be applied by the people through their representatives in Congress, and the people must require an immediate and faithful discharge of this duty.

It must be evident to all in the first place that the conditions

and environment of our national life have been entirely changed as one result of the war. A national consciousness has been aroused to the fact that we are no longer a secluded, though great and powerful people, separated and protected from the other great nations of the earth by the seas which surround us, but standing among them a peer among peers, in close relations, with rights which we must maintain and responsibilities which we must discharge. The oceans which once were our protectors have become the open avenues of international communication and contact, and the necessities of the times require us to be constantly prepared to preserve our domestic peace, to defend ourselves from foreign aggression, and to perform our whole duty to humanity among the armed nations of the world. We are not to be permitted hereafter to devote our entire energies to the promotion of our own selfish interests and the enjoyment of prosperity, but are compelled to tax ourselves for security, and the effectiveness of our international influence. The very numbers of our people and their wealth, when they invite attack, change like our oceans from safeguards to dangers. In close contact and constant commercial and social intercourse with all the world we are now compelled to display such a state of naval and military preparation at all times and places, as will command a respectful consideration for our rights and the influence upon mankind to which our national power is entitled.

It seems to be generally conceded that our navy must be sufficiently increased to enable it to protect our own coasts by patrol as well as by defensive distant operations, and our commerce and our citizens all over the world. Providence appears to have actually thrust coaling stations and strategical positions into our hands against our will in such a way that we are obliged to enlarge our naval power, or shamefully abandon advantages which other nations would be willing to fight for. These considerations, together with the glory which the marvellous victories of our navy has won for the country, lead Congress just now to respond more readily to our naval than our military requirements. Without disparagement of the equal importance of naval preparation we will confine this discussion, however, to the land force which our present situation requires us to maintain.

It must be admitted as an axiom that, however essential a well trained and disciplined body of soldiers is to military success, and training with discipline in military operations have never before been so essential as now, when skill and science are equally necessary in the effective use of modern weapons of war, both great and small, a Regular or standing army, sufficiently numerous for military operations in time of war is so repugnant to our institutions and popular sentiment as to be entirely out of the question. But popular sentiment has been considerably modified by our recent experiences in regard to the value, sphere of utility and proper proportions of our Regular army, as well as in reference to timely preparation of coast defenses and munitions. It has been made plain to our coast line citizens, at least, that our ports can be made impregnable against the most formidable fleets when adequately fortified with mines and long-range guns mounted on disappearing carriages, which it takes two years to make, if they are abundantly supplied with smokeless powder and costly shells, and are manned by skilled and practiced gunners, directed by trained and scientific officers. Neither the fortifications, the guns, the ammunition or the men can be furnished in time to be useful after war has come by even seventy millions of people with an unlimited treasury. All these things must be prepared and made ready in time of peace and before they are needed, or our cities and their wealth are an easy prey. The guns are as useless without ammunition as without men, and the men are as useless without training as without guns. Our extensive coasts and numerous ports require not only an extensive fortification, but a much larger force of trained officers and men than has heretofore been considered sufficient for protection. Every hundred feet square of possible approach within range, for instance, must be plotted and mapped; the direction, elevation and charge of the gun and time-fuse of the shell calculated and tested for the striking of the enemy at each particular place, and the men trained to handle the machinery to do this work. They are liable to be called upon to do this on a week's notice at any time. Such service cannot be expected from hastily recruited levies; it can only be rendered by Regular soldiers who make it the profession and business of life.

Although this is written before peace has been declared, or the conclusions of our Commissioners made known, it is evident that one of the results of the war has devolved upon this Republic the care and protection of at least three distant island territories; Hawaii, Guam in the Pacific, and Puerto Rico in the West Indies, where permanent garrisons must be maintained sufficient, not only for occupation, but for the protection of important naval stations, with costly dry-docks, stores and fortifications; and the responsibility for the preservation of peace and order, the material development, education, and civilization of the great island of Cuba, the "Pearl of the Antilles," and of the many millions of half savage men in the rich and productive Philippine Archipelago. However much we may shrink from these great undertakings, the compulsion of events will not permit us relief from them, and for many years we shall be obliged to maintain large forces in their widely separated localities from our Regular army. We have got two bears by the tail on opposite sides of the world, and we cannot let go.

Morally this war has emphasized and more generally impressed the people with the dearly bought lesson which was given by our Civil War, that the Regular army of the United States must be organized in time of peace as the skilled experts, the nucleus and skeleton of whatever force the nation is likely to suddenly require in time of war. The peace establishment must be greatly enlarged not alone to satisfy the police requirements of seventy millions of people, man its fortifications, discharge the multiplied and increased responsibilities devolved upon us by our insular dependencies, in such a manner as to admit of an immediate expansion by raw recruits to double its numbers, and, at the same time to allow a draft from it of educated, trained and tried general and staff officers for a volunteer force of at least three hundred thousand men in time of war, without impairing its efficiency. The consensus of popular opinion seems to be that we shall require in future a Regular army about one hundred thousand strong. Such an army, the smallest by far maintained by any of the great nations, could neither endanger the institutions of seventy-five million of freemen, nor unduly burden their exchequer. Sociologically, it would provide an honorable and useful career for

many who, born to be soldiers, are unfit for other occupations, and immensely reduce the cost in life, suffering and money in future emergencies.

The first duty of Congress will be to crystalize this will of the people into legislation which shall institute such an army. It should be constituted upon its peace basis of a minimum of privates in the units of its organization, but a full complement of officers and large staff corps in the Adjutant General's, Engineers, Ordnance, Quartermaster, Commissary, Medical and Signal Departments; in all of which, except the Medical, line and field officers should be required to serve a tour of duty, and from which the General of the Army should be authorized to detail, upon the application of Governors of States, officers for the instruction of the militia. This last provision would provide the education and employment of several hundred more officers than could be assigned continuous duty in the army alone, and allow the promotion and transfer of an equal number to duty with volunteers in an emergency without weakening it. The Commanding General should be authorized to nominate his chief of staff corps, and his army and corps generals; the army and corps generals their division generals; the division generals, their brigade commanders, and all commanding officers, in order of their rank, their own staff officers.

A large and reprehensible part of the loss of life, the hardships and sufferings, disease and expense of our Spanish war, when traced to the actual causes, will certainly be found to have been due to our total lack of preparation for war, and to either the ignorance, inexperience, or incapacity of commanding and staff officers. For both of these causes, Congress, and not an Administration which achieved a triumphant victory, notwithstanding all these unnecessary obstacles, is responsible. If the next session of our National Legislature neglects for any reason to heed the terrible lessons our people have received, it will indicate an alarming weakness in our form of government. Sound judgment must recognize the absurdity of the bigoted cry of "militarism" and "imperialism" against an army numbering only one in a thousand of the freemen who create and support it.

To sustain the position we now occupy among the great

powers, with the requisite foreign and self-respect, and to protect ourselves from unwarranted attack, it will be necessary that we should constantly display the ability to put from four hundred thousand to five hundred thousand men under arms, well organized and supplied, at the shortest notice. With an army of not more than one-fifth of this number, this is not possible without an organized militia. Our Constitution, and our statesmen from Washington to the present time, have proclaimed the militia to be the safeguard and reliance of a free people, until it has become an axiom of almost universal acceptance by the people, but we have for a century entirely neglected to make its national use possible by legislation. Some States have, indeed, more or less proficiently organized small bodies of militia, for temporary service within their own boundaries, and for this service they were efficient. The division of Pennsylvania National Guard, with which I had the honor of service for many years, was officered by men who had been carefully examined as to their qualifications at every promotion, was accustomed to taking care of itself in camp for a week every year, its privates were all sharp-shooters; it had performed lengthy tours of duty in camps for the preservation of order in the State. If it had been called out as a whole with its accustomed commanders and their experienced staffs for temporary service by the President until the volunteer army had been organized, I am confident almost every man would have gone. A large proportion of its members would have volunteered, while its own organization would have been maintained complete by the filling of vacancies; it would have rendered as brave and efficient service in the field as any; it would have been well provided for in camp and field, if the needed supplies were in reach of its commanders, from generals to captains, and its own sick list would have been at the minimum, as not only its officers but the men had learned to take care of their health in camp.

The enlistment of these State Guard Organizations in the service of the United States for two years in such a way that every man was under the compulsion of fear that he would be considered a fair-weather soldier or coward unless he volunteered, at a time when thousands of strong young men were begging

for a chance to volunteer, not only was a great hardship to many who ought not to have left dependent families or important business, and so became a prolific cause of discontent and sickness among the volunteers, but has eliminated from the State Guards many organizations which had valuable local associations and *esprit du corps* resulting from many years creditable service, destroying at one blow the results of much labor and military enthusiasm.

It is not probable that the National Guard can ever be resuscitated under State laws to the condition of even its former efficiency. The whole system has utterly broken down as a national defense and been broken up as a State force. It could scarcely be otherwise. Organized, where it was organized at all, not on a basis of populations, but according to various opinions of different State legislatures upon local needs for the preservation of order, the President, distributing his call for troops upon the basis of the enrolled militia in each, was obliged to break up some good organizations and accept many without any military knowledge. The organizations varied in uniform, equipment and discipline to such an extent that it was impossible to consider them an effective army. Their guns were of different make and calibre, and some of obsolete styles, so that they could not be easily supplied with ammunition; a few had tents, but none cooking utensils, wagons or ambulances. Six months after enlistment they were still drilling with the Springfield guns which had been proven useless against modern rifles at Santiago. There had been no target practice in the Northern camps; few had ever fired a smokeless powder cartridge and many recruits were said to be so unfamiliar with their weapons as to be afraid to fire them with blank cartridges on drill.

With the purpose of providing a National Guard which can be depended upon as a picket guard and temporary reinforcement to the army in sudden emergencies, while volunteers are being enlisted and drilled, of maintaining the military spirit to some extent among the people, of educating the young men in the rudiments of military matters, and affording an attractive career for those born soldiers who are found in every nation, a bill has been carefully drawn by Col. F. L. Hitchcock—a lawyer who rose from lieutenant to colonel, during a full three years in

the Civil War, and has since served twelve years in the Thirteenth Regiment National Guard of Pennsylvania—which will correct the present lack of legislation, remedy many of the evils to which we have hitherto been exposed, and avoid many of the objections made to other proposals.

This bill directs the President to organize a portion of the militia, in the aggregate three hundred thousand men, distributed among the States according to population, to be known as the National Guard of the United States. They shall be enlisted for three years and be officered as now provided by the several States. They may be called into the service of the United States for a period of six months only once in three years, and shall be ordered into large camps of instruction and manœuvre for twenty-one days each year. When in the service of the United States and in camp officers receive the same pay as in the Regular army; privates, $1.00; corporals, $1.50; sergeants, $1.75. When not in the service of the United States they shall be subject to the laws and the orders of the Governors of their respective States, which shall provide their uniforms and armories. The President shall prescribe the system of drill and discipline; issue to the various organizations arms, ammunition, all field, camp, garrison, and rifle practice equipage; tents, wagons, ambulances, and other supplies in sufficient quantity for actual duty, which shall remain at the various battalion, brigade and division headquarters as the property of the United States, and subject to inspection. He shall detail, upon the application of the Governor of a State, officers of the Regular army for a tour of duty as staff officers and instructors of the various organizations, and such general and staff officers as may be needed in the annual manœuvres, who shall receive the pay of the rank to which they are assigned. A bureau of the National Guard is provided, and inspectors for each State, to rank according to the importance of their duties. The President is directed to organize the quota of any State which refuses or neglects to provide one, in which case the guard of that State becomes exclusively United States Guards.

A term of service in this National Guard exempts a man from liability to draft until all other able-bodied men have been drawn. The President is directed to pay from the United States

Treasury the expense of executing the provisions of this bill, and twenty millions of dollars, if necessary, are appropriated for this purpose. Let us consider what the enactment of such a bill would effect.

It would give us a well organized and equipped body of three hundred thousand men always ready for an emergency call to "hold our forts" until an army could be organized, at a minimum cost.

It would render a Regular army of seventy-five thousand men sufficient for continuous maintenance, instead of the proposed one hundred thousand, and thus provide three hundred thousand men at a large saving on the cost of twenty-five thousand.

It would provide for the continued maintenance of a store of arms, ammunition, and supplies for a large army.

It would give officers of the army opportunity in the annual encampments to acquire experience in the command of large bodies of troops, the selection of camps, the transportation and movement of troops, in the proper subsistence and care of the health of large bodies, and accustom staff officers to their duties with armies in action.

It would train a large number of officers among the people as well as in the army for responsible positions when volunteers should be called for, and enable the Commander-in-chief to inform himself from the Inspector's records concerning the qualifications of all.

It would accustom a large body of citizens to the use of modern weapons of precision, to military organization and camp life, so that they could protect themselves, when called to volunteer, from the Regulars of an attacking nation and not become mere food for powder.

It would encourage the necessary maintenance of a military and patriotic spirit among the people and open up a way for selection and promotion of young men of military tastes and ability into the army.

By the commingling of the men of various States in the annual encampments it would tend to obliterate sectional sentiments and antipathies, and promote the growth of a national patriotism just as the Spanish war has done.

It would display to the world, with our Regular army expanded to one hundred and fifty thousand by recruiting, a force of four hundred and fifty thousand men ready at all times to defend our country, to ward off many attacks which a defenseless condition would invite, and give to our policies and influence in the councils of the nations somewhat of the weight to which our numbers and power are entitled, thus becoming a conservator of peace.

If the United States had been thus prepared to enforce her demands upon Spain in the period of diplomacy preceding the war, there is no reason to doubt that Spain would have evacuated her West Indian possessions without bloodshed, and we should have saved the losses in life, treasure and the suffering which our criminal neglect has cost us in this war. More than enough in money alone, probably, to have maintained such a National Guard for forty or fifty years, as the annual cost, it is estimated, would not exceed five million dollars, after it is once equipped. Much of the equipment purchased for the war could now be utilized for this purpose instead of being sacrificed at auction sale, as will otherwise be done. This annual cost is so insignificant in comparison with the enormous advantages assured by it that it would seem there could be no hesitation or delay by Congress in passing the bill.

Such a National Guard will not only attract to itself the young men of military taste and talent, but afford an opportunity to weed out the incompetent and inefficient by means of the examinations and inspections which would be constantly made of officers and organizations, and to insure a much superior grade of talent to officer the hasty levies which must be made for war. The losses from disease in our Civil War were more than sixty-six per cent. of the total deaths of soldiers, and the pensions paid to survivors are likely to exceed the total money cost. Our losses from disease in the Spanish war are figured by the official lists to September 30, 1898, as over eighty-eight per cent. of the total. A large part of these losses must be attributed to improper care of officers. Under proper care camp life, for strong, vigorous young men, should be a healthy life. There is no good reason why such men as pass the rigorous medical examinations to which our soldiers are

subjected upon enlistment should be more liable to sickness and death living in camps under intelligent and experienced control than in their homes. They should, rather, become more and more rugged.

Hundreds of thousands of men hastily gathered into camps without instruction, discipline or equipment, with ignorant officers, are but a helpless mob; sheep for the slaughter by the enemy, or by disease if the enemy prefers to save his powder. The competence of officers, and especially of subalterns, constitutes the strength of an army and the real difference between such a helpless and pitiable mob of patriotism and an actual army. The terrible losses of our recent wars, the warnings of all our military men, from the greatest generals to the private soldier, the common sense of every man who will reflect a moment, all teach that the most serious problem of our next war will be the securing of competent officers for the hosts we can count upon for our defense. Of West Point graduates, there cannot be more than twelve hundred below the age limit of forty-five years, while we should require nearly twenty thousand for an army of half a million men. The most practicable school and source to draw them from will be such a National Guard as is here proposed.

Two thousand four hundred and fifty-seven years ago, Cyrus, who became one of the eight or ten greatest commanders the world has known, started from Persia with his first independent command, being then forty-one years old. His father, Cambyses, the King of Persia, accompanied him to the frontier and took occasion to inquire what those most able masters he had provided his son had taught him concerning the duties of a general. "They have taught me to fence," said the prince, "to draw the bow, to fling the javelin, to mark out a camp, to draw the plan of a fortification, to range troops in order of battle, to review them, to see them march, file off, and encamp." Cambyses gave his son to understand that they had taught him nothing of what was most material and essential for a good officer and expert commander to know, "that is to say, concerning the supplying an army with all necessary provisions, of preventing sickness, and preserving the health of the soldiers, of fortifying their bodies by frequent exercise, of exciting a generous emulation

among them, of making yourself obeyed and beloved by them." Such knowledge cannot be altogether acquired theoretically, but a few annual encampments of full army corps, although of only brief duration, will give officers and men an experience which, when the supreme test of war comes, will save thousands of lives and disabilities, as well as enable the General-in-chief to so test the officers of the army in the management of large bodies of troops as to measurably relieve his nominations to important commands in time of war from the baleful control of either seniority or political influence.

The distinction of a national service, the enlarged chances of promotions, the increased importance of the duty, the broad scope of the instruction offered, the limit of the possible call into active service, the opportunities for travel and grand military pageants in the annual encampments, and the improvement which will appear in the physique of its members, are likely to render patriotic duty in such a National Guard sufficiently attractive to enough of the young men of the country to keep its numbers always at the maximum with a constant waiting list of recruits. The liberal pay will relieve its members from the burden of the money contributions which most State Guardsmen have been obliged to add to their contributions of time, and the patriotism of employers and the people in general will rally to its support.

A carefully fortified coast, an adequate navy, a Regular army of seventy-five thousand, capable of expansion to double its numbers, an efficient National Guard of three hundred thousand citizen soldiers, and an ample store of arms, ammunition and war material are each and all equally essential to our public security, to the stability and permanence of our republican institutions, to the promotion of domestic prosperity, and to the vitality of our legitimate and logical influence among the nations in the progress of civilization and the development of mankind.

As the President has so eloquently and powerfully said, "the duty of the hour now devolves upon Congress." That duty has never been so plain and imperative. Let the legislators of the people have care lest by the neglect of any of these things in the solution of the many new problems pressing upon them they turn aside or check the tide of national destiny at its majestic flood.

NOTES ON SMALL-ARMS AND AMMUNITION.*

By Colonel JOSEPH PEARSON FARLEY, Ordnance Department, U. S. Army.

"PRIOR to the Civil War all inventive thought was concentrated on the gun as the primary factor. But when the centre-fire metallic cartridge was developed —presto! Science had put on its seven-leagued boots. The change to the breech-loader took place at a bound.

"The ordinary notion is that powder and ball are mere accessories to the gun; that the gun is the all-important and substantive thing, while the cartridge is a minor incident. So all-prevailing has this idea been in times past that even the most expert have been not only influenced by it, but sometimes governed by it. The truth is the opposite. The cartridge is primary and antecedent, the gun secondary and consequent."†

With the advent of smokeless powder a great advance has been made in the development and perfection of the metallic cartridge. The metallic case (brass) is the embodiment of the obturating or gas check principle—a vital and essential element of all small-arm breech-loading systems, supplanting, as this metal case does, a great variety of imperfect gas checks directly or indirectly attached to the mechanism of the rifles themselves. The inefficiency of the old types of obturators has rendered many breech-loading small-arms obsolete, and even at a time when such arms were in service, their inferiority to muzzle-loader competitors was most decided. The earliest metallic cartridge product of the United States factories was of the rim-primed, folded-head type. This was followed by the bar-anvil, and this again by the cup-anvil, inside-primed cartridge, which is shown at Fig. 1.

* The publication of this essay, by permission of the Chief of Ordnance, U. S. A., is not to be understood as a mark of official sanction of the opinions expressed therein, the author being alone responsible for the views set forth in this paper.

† Historical Sketch of the Ordnance Department, U. S. A., Major C. E. Dutton, U. S. A.

This latter was followed by the outside primer folded head, Fig. 2, and this again by the Martin patent double fold head, Fig. 3.

FIG. 1.

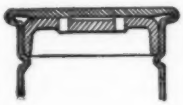


FIG. 2.

FIG. 3.

FIG. 4.

FIG. 5.

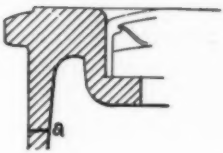


DIAGRAM A.

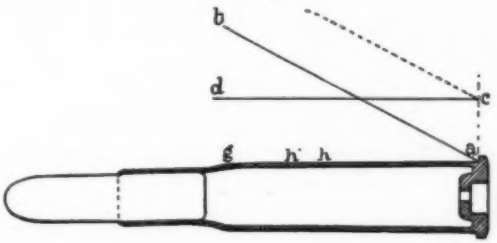
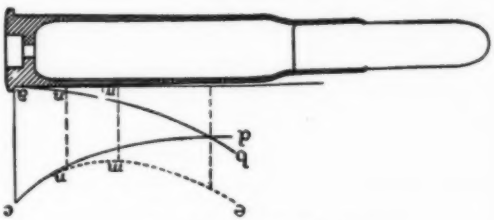


DIAGRAM B.



(See Figs. 7 and 8, Plate IX.)

THE CARTRIDGE CASE.

The folding in of the cartridge shell, like the winding of wire in a spiral wrap, was intended to provide for the extension and unfolding of the metal necessary to compensate "head

space" in the rifle (from face of bolt to base of cartridge), and in this manner to prevent a transverse rupture in the shell, under longitudinal strain.

Transverse rupture with this, the folded-head type of cartridge, occurred, if at all, in the bend or sharp angle of the head, that being the weakest point.

To provide against a defect of this nature, the folded head was succeeded by what has been designated "the solid head cartridge," shown at Fig. 4, and this, in an improved form, is shown in Fig. 5, representing, as it does, the present cartridge case for the .45 calibre Springfield rifle.

A transverse rupture rarely occurred in this cartridge case under the moderate stress or gas pressure, incident to the employment of the black or smoky powder charge, and when it did develop it was on some section, such as "*a*" in advance of the head or rim.*

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*Rupture in a cartridge case destroys, of course, its useful purpose as a gas check and induces, perhaps, other serious consequences. Without, however, entering upon a labored explanation of causes of rupture whereby the cartridge case as a gas check may be destroyed it yet may be of interest to the reader to note the relation of applied forces graphically expressed by diagrams A and B. These represent a cartridge similar at its base and in its walls (excepting the choke and reduced neck), to that of the .45 calibre Springfield rifle cartridge.

Briefly stated, the walls of the cartridge from "*a*" to "*g*," being uniform in thickness, the case should expand equally over this surface, and the frictional resistance to longitudinal stress at any cross section of the case between the limits specified, must be measured by the product of the pressure on the whole surface, in rear of the selected section, by the "coefficient of friction" of the metal of the cartridge on the metal of the rifle bore.

The hypothetical conditions are such in this instance that the frictional resistance curve, reduces to a straight line, with origin at or near "*a*," and making with the axis of abscissas an angle such as the "coefficient of friction" shall determine.

An ordinate of the friction line, at any section, will therefore express the frictional resistance to longitudinal motion at that section.

So in like manner the resistance to longitudinal strain throughout the walls of a cartridge case of uniform thickness and homogeneity of wall structure, should be expressed by a line such as *cd*, parallel to the axis of abscissas, that is, with equal ordinates, expressing equal resistance to uniform longitudinal strain throughout.

From this we conclude that if the friction and resistance lines or curves in either diagram *A* or *B* be correctly determined that section at which the sum of the ordinates of the two curves or lines *ab* and *cd* is a minimum will be the section of transverse rupture, if rupture there should be. This minimum sum of

A moderate and well regulated head space in small-arm rifles should preclude the risk of transverse rupture of cartridge case. Not so, however, when the ammunition is employed or interchanged for machine-gun service. In the latter weapon there is risk of false adjustment, since this class of small bores is provided with a means for adjusting the "head space." Hence it is, that too much care cannot be exercised in regulating this feature of the arm with nicety.

Machine guns, of all others, are the ones in which cartridges should not be fed into chambers containing the ruptured cases of fired cartridges, as the gun will at once be blocked, and, possibly at a critical juncture, rendered for the time unserviceable.

The most likely or probable rupture of a cartridge case is in its neck, wherein the metal, "wearied" by its prolonged grip on the bullet, may split longitudinally, either before or in the act of firing. This is not a serious defect and has been compensated by running "a cannelure for crimp" at that point on the bullet where the front end of the cartridge grips it.

Loose-fitting bullets are, by means of this cannelure, held in place, and the cartridge case metal at the neck relieved from the constant stress on the bullet due to a close fit on the whole length of the neck.

Minute folds in the choke of the metal case, due to the process of reducing the case at the choke of the neck, have also been a source of trouble. These folds, though visible only under the magnifying glass, are not in evidence at any time, until after the cartridge has been fired, and even then but rarely discover themselves except by a discoloration of the case on its exterior surface, due to gas escape.

The process of working the metal for the cartridge case from the plate or strip is accomplished by cutting out a disc and forming it into a cup, then, by successive drawings, extending the cup to the proper lengths; the partially formed cases being annealed between each draw. The case, when trimmed to proper

ordinates will be the minimum ordinate of the curve "ce," all the ordinate of which at each of its points being the sum of the ordinates of the other two curves at the corresponding points.

Referring to Diagram *B*, we find certain relations expressed for the .30 calibre cartridge case as at present adopted and adapted for the smokeless powder charge now used with the United States magazine rifle (Krag-Jorgensen).

length, is slightly tapered to facilitate its withdrawal (after the cartridge is fired) from the correspondingly tapered chamber of the rifle. The reduction at the front end or neck of the bottle-shaped cartridge can only be effected by "forcing" after a special annealing. As the metal cannot flow, in this operation of forcing in the die, it must of necessity lap or fold in the choke of the neck, leaving minute lines of weakness at this point through which the powder gas may find escape at times; but this is attended with no such serious consequences as those following gas escape near the base of the cartridge. Breaks of this kind merely impair the usefulness of the cartridge case for refilling and repeated service.

THE CARTRIDGE PRIMER.

The cartridge primer consist of primer cup and anvil; both of copper, primed with .2 to .25 grains of composition, for the .45 calibre black or smoky powder cartridge, or with variable and greater proportions of composition for smokeless powders to overcome resistance to ignition.

The explosive effect of a small priming charge, associated as it is with but moderate reaction (24,000 pounds per square inch), due to the combustion of a black powder charge, rarely, if ever, develops cracks, splits or punching of the primer cup under well regulated blows of the firing pin, the form of the pin being well adapted for its purpose. The thickness of cup and anvil, and the dimensions of the pocket in the cartridge case, have likewise been carefully determined.

Copper has been preferred to brass for the primer cup and anvil, since the fulminate of mercury forming part of the priming composition in contact with the alloy of zinc and copper, deteriorates by galvanic action both the priming composition and the metal itself. Where brass primer cups or anvils are employed, a tin coating of this alloy, conjoined with varnish and tinfoil casing for the priming, are useful and necessary adjuncts,* more particularly where the ammunition supply is to be a reserve and to be stored for an indefinite period.

* Tin foil and varnish are needed for protection in the make-up of the cartridge primer, since copper will reduce insoluble mercurial salts when moist and mixed with suitable chemical agents. Fulminate of mercury, from the little affinity of its component parts for each other, is readily reduced when

The flat and thick copper anvil for the primer of the calibre .45 cartridge lies snugly up against the priming composition; and owing to the small priming charge (.25 grain), is in close proximity to the interior surface of the priming cup. See Fig. 6, Plate IX.

The risk of miss-fires is, therefore, inconsiderable in this combination, while with the combination for the .30 calibre cartridge, a curved anvil compensates the cushioning effects of the larger charge of priming composition required for the later and more obdurate powders. See Fig. 7, Plate IX.

In the first instance the .45 calibre cartridge primer was employed with the less obdurate class of smokeless powders, but this has of late been followed by the curved anvil type of primer, previously noted.

THE CARTRIDGE PRIMER COMPOSITION.

The composition for the calibre .45 cartridge primer, consists of the following ingredients:

Fulminate of merury (moist) . .	64.00	.2 grain.
Chlorate of potash	18.00	
Glass	18.00	
	100.00	

mixed with chlorate of potash by contact with copper. But this reduction is to a great extent surface only, since, when the metallic surface is amalgamated, further action ceases almost entirely. Where brass is employed the action is not confined to the surface, but penetrates the metal, rendering it porous, and in time disintegrating it, and requiring the use of varnish or other substance as an intermediary.

There is another and most important chemical reaction due to the primer composition which should be noted. In the .35 to .4 grain of priming composition for the obdurate class of smokeless powders, that is, powders difficult to ignite, there is about .2 of a grain of the fulminate of mercury which, after conversion to mercurial vapor under the intense heat of smokeless powder gas condenses at the choke of the bottle shaped neck of the cartridge case.

No harm results from this if the cartridge case is soon after reloaded and fired, say, a dozen or twenty times. If, however, after the first round fired the case be laid away for a time, the mercury attacks the zinc of the brass and the case frequently becomes as brittle as glass. A primer without fulminate of mercury may be found to overcome this difficulty, but with such primer there is a risk of loss of efficiency with consequent miss-fires.

With the mealed powder added for the calibre .30 cartridge primer, the constituents are as follows:

Mealed powder	1.50	.3 grain.
Glass	18.00	
Chlorate of potash	19.00	
Fulminate of mercury (moist)	61.50	
	100.00	

Of late the following proportions have been found to ignite, successfully and without hang-fires, powders of the Troisdorf or obdurate type:

Fulminate of mercury (moist)	59.37	.35 to .4 grain.
Chlorate of potash	21.89	
Glass	15.62	
Mealed powder	3.12	
	100.00	

THE BULLET.

Prior to the appearance of the calibre .30 rifle cartridge with its smokeless powder charge and jacketed bullet, a proper selection of kind, quantity and method of lubrication was of the first importance, since the bullet was almost wholly of lead or else only moderately alloyed with tin or antimony (1 to 16). Exhaustive tests with the calibre .30 bullets resulted in the adoption for service of a cupro-nickeled steel-jacketed bullet without cannelures or lubricant. A trial of many thousand rounds proved its superiority in point of accuracy over a similar bullet cannelured and lubricated.

At this writing a bullet jacket made of steel, cupro-nickeled on its surfaces to prevent oxidation, and fitted with a core of lead but without lubricant, constitutes the service projectile for the United States magazine rifle, model 1896.

Cupro-nickeled steel should not be confounded with metal nickel-plated by galvanic process, nor with nickel steel. This special metal is plated by means of welding in the fire cupro-nickel plates with steel plates and then rolling them into sheets. Cupro-nickeled plates, the nickel being welded on steel plates, are made according to special requirements with nickel

on one or both faces, in layers of 5 per cent. to 10 per cent. of the total thickness of the metal.

The weight of the United States service bullet calibre .308 is 220 grains with density of section the standard; that is, 3000 grains per square inch of cross section. In form it may be described (starting at its base) as composed of a cylinder for .5 length, frusta of cones .02 and .445 lengths respectively a frustum of a spindle .187 and a segment of sphere 1 length; the total length being 1265 or four and one-tenth calibres nearly.

The greatest obtainable density in the bullet metal is always a condition precedent, provided, however, that it be accompanied by no material degree of hardness like that due to the use of tungsten, platinum, virdium, osmium or alloys such as ferro-tungsten or steel. These metals or alloys, if it were practicable to use them for the purpose specified, would, by their excessive hardness, wear away the bore of the rifle. On the other hand there should not be too great plasticity, such as we find in pure unalloyed lead, since the latter property may induce irregularity of form in the bullet, while passing through the rifle barrel.

Lead "deforms but little until the velocity exceeds 400 metres; when, however, this limit is passed the plasticity and fusibility of lead becomes inconvenient." "Lead bullets with 490 metres initial velocity melt at the surface, due to friction in bore, with loss of the fused portion in the gun or in the air," and accuracy of flight is, in consequence, altogether destroyed.

It is said that England was the first country (1867) to adopt a lead bullet hardened with tin, and it was not until ten years later that other countries followed her example.

France, in 1883, hardened her bullet with 5 per cent. of antimony, which proportion, it is claimed, gives the same hardness as 10 per cent. of tin, but alloys of lead with both of these metals are very homogeneous, and in proportion to an increase of lead or antimony the bullet becomes less fusible.

"If the velocity exceed 460 metres, 5 per cent. antimony alloyed bullets become deformed and even melt, especially when black powder is used, which, by its residue, roughens the surface of the bore." When the velocity attains 700 metres these hardened bullets melt, a third of their thickness being fused and the remainder much softened.

BULLET JACKET.

Metallic jackets for bullets are required to be of metal which fuses with difficulty and will not strip from the bullet. "The first application of the metallic jacket was simply for the purpose of replacing the paper envelope and had no reference to rigidity in the bullet." (Bullet jackets are made by drawing, in a manner similar to that before described for the cartridge case.) This rigidity, at first an incident, is now a prime factor in the make-up of the bullet, but it must not be carried to an extreme. "Brass jackets stand condemned, since they not only tear apart in the bore, where the mean velocity is much below that of the muzzle velocity, but the metal of such jackets grinds against and wears the steel off the rifle bore."

Copper jackets, experimentally employed, have given good results in our service, but it is known that with the higher velocities they afford inadequate protection for the lead core against fusing. Copper being a too good conductor of heat for the purpose, and expensive to manufacture, has on this and other accounts been discarded for bullet jackets the world over. Copper may be nickel-plated on the exterior, but, in firing, it is said that "the layer of nickel becomes detached and acts like a hard metallic powder and increases friction against the bore." Steel jackets are held to wear out the surface of the bore of a gun, but Norway iron, decarbonized, surfaced with cupro-nickel, shows no material wear of the rifle bore after several thousand rounds fired.

And now, while we are on this subject of bullet jacket metals, a word may be offered.

MISAPPREHENSION RELATIVE TO BULLET JACKETS.

It has been said, though incorrectly, as will be seen, that the Spanish Mauser bullet jacket is of brass, and this with intent to induce blood poisoning; but, on the other hand, we learn that the wounds inflicted by the bullet of this rifle yield readily to treatment. It is also stated, though incorrectly, that the jacket of the United States navy magazine rifle bullet is of pure copper, and therefore an anti-humanitarian bullet of the first order. The United States army bullet, calibre .30, carries, as before stated, over its lead core or filling a Swedish iron

or steel jacket plated with nickel, to prevent rust. Cupro-nickel alloys, such as German silver, are also employed for bullet jackets in foreign services, but alloys are always treacherous and uncertain, and defective jackets of such alloys would discover themselves in the United States service, where rifle practice is general throughout, whereas in other services defective ammunition might escape detection.

Now, it is well understood that for each and every reduction of calibre, in order to preserve the proper relation between the area of cross section of the bullet and its weight, the length of bullet estimated in calibres must disproportionately increase, until, in the smallest calibres, the bullet may approximate six calibres' length, as against two and one-half for the United States service .45 calibre bullet. The "radius of gyration" materially reduces, for each reduction of calibre, and the "angular velocity" proportionately increases through the agency of the rifle twist. The rifle twist of the .45 calibre, not exceeding one turn in 22 inches, will not cause the lead bullet, moderately alloyed with tin, to shear off its surface or "strip" on the "lands" of the rifling, whereas, the sharper twist of the .30 calibre rifle, one turn in 10 inches, with the higher velocity projectile, requires the jacket casing to be of a metal more resisting than the lead and tin alloy.

To return to the main point, the brass jacket. It is thought, and indeed it is known, that for such reasons as are here presented, they could not have been, nor were they calculated, for the bullet of the modern Spanish Mauser rifle, although it is known that other weapons of an inferior kind and of earlier origin have been provided with ammunition that is now quite obsolete. The brass jacket has long since been discarded, since, as before stated, this alloy breaks up in the bore of the rifle; not only destroying the accuracy of the bullet, thus impaired in form, but rendering the rifle itself dangerous for succeeding shots. It is in fact an intolerable condition that any foreign material (more particularly metal) should be lodged in the bore of the rifle.

Copper for the jacket is not so brittle, and since it is a good conductor of heat, permits its lead core or filling to fuse. When coated with nickel to reduce its blood poisoning effects, the nickel coating crumbles into powder, and fills the

rifle grooves, this defect, as well as that resulting from fusion of bullet core or lead filling is accompanied by a wild and dangerous flight of projectile.

BULLET WOUNDS.

The deductions to be drawn from what goes before are perfectly clear, and show that, if the wounds inflicted by modern small-arm bullets shall be found to be of a cruel nature we must search for the cause elsewhere than in the metals' chemical action. There is a zone wherein the bullets of modern rifles travel with extremely high velocity, within it may be 300 yards of the firer, and within this zone, the effect of bullet impact on flesh is not unlike that which might result from an actual explosion of the bullet itself. In fact, instances are cited where bullets fired into wet sand incased in a sealed can or box, or into liquid hermetically confined, resulted in the bursting out of the can, as if there had been an explosion therein; whereas when dry sand was used no such explosive effect was manifest. This was at one time attributed to an action akin to that of hydraulic force, but, reckoning the volume of a closed vessel containing a liquid as increased only by that of a projectile, it was realized that the increment of volume or surface pressure of the liquid was insufficient to account for the force developed. If on the other hand, the velocity of the bullet, together with the readiness of fleshy matter or its particles, in the path of a bullet, to take up and impart motion to other and adjacent particles be considered, it is believed that cones of dispersion must develop within the human frame under conditions of penetration, and that the effect is in all respects akin to that which might result from an explosion of the bullet itself.

In considering the subject of bullet jacket material, and influences which were probably operative in the determination of that material, we cannot ignore the fact that ricochet shots and penetration of gravel before impact upon the human frame may so strip a jacket of any metal from its filling or lead core as to inflict a cruel wound, and that likewise the bone resistance in the body struck, may equally strip the jacket *; but,

* Stephen Bonsal, in his interesting article "The Night after San Juan," says: "To the crackling sound of the Mauser bullets, to the song of the shrapnel as they tore their way through the jungle, and amid the sharp *exploding reports* over head (the italics are ours) which gave rise to the belief among our men

withal the punishment inflicted does not equal that of the larger calibre lead bullets, more particularly as the latter class are very apt to "*mushroom*" badly on impact against bone.

SMOKELESS POWDERS.

Several smokeless powders were tested about the year 1885, and from these the modern smokeless powder has been gradually developed. "The explosive substances principally employed are as follows: Nitrocellulose, nitroglycerine, nitrosaccharose, nitrobenzine, nitronaphthaline, picric acid, etc. In connection with one or more of these mentioned certain solvents are used, such as sulphuric ether, ethyl acetate, acetone, etc.; also inert bodies or "retainers," camphor, paraffine, stearine, benzine, acetine, vaseline, etc." (see Table II).

"While the same variety of black powder can be used with equal facility in small-arms of different calibre, it is found that each special calibre requires a different variety of smokeless powder. This influence of the calibre becomes more noticeable in small-arms as the calibre is reduced, the weight of the bullet being maintained. Thus a powder gave to the 216-grain bullet fired in the calibre .315 rifle an initial velocity of 2100 foot second, with a maximum pressure of 24,000 pounds, while the same powder and weight of bullet in the .30 calibre rifle gave the same velocity with a maximum pressure of 45,500 pounds per square inch. We must then have a special proportion of

that the Spaniards were using explosive bullets, the wounded were taken out" * * * and then in foot note in this connection he adds: "These reports which sounded so much like explosive bullets were doubtless occasioned by the separation of the copper jacket from the bullet in mid air. The Spaniards harbored the same suspicion of the ammunition that we were using as we did of theirs. It is doubtless only another example of how unacquainted both armies were with the effect of the small-bore, flat trajectory rifles."

Let us understand this!

In the formula $Rs = \frac{1}{g} M [V^2 - V_1^2]$ by proper substitutions the mean resistance of the air over the .30 calibre bullet's path of one mile will be determined as one-third of a foot pound—or over the first 200 feet of bullet's path this mean resistance will not exceed one foot pound, or say three foot pounds for the maximum air resistance. The maximum powder pressure on the base of the bullet in the gun is 2824 foot pounds. If the bullet jacket and its lead filling or core do not part company under this pressure, how can the lesser air pressure accomplish such result? Thus we see that it is the theory which explodes and not the bullet. In fact, the penetration of the .30 calibre bullet, of from 20 to 30 inches in green oak, *across* grain, without the slightest deformation, expresses the adhesion of the bullet system.

powder for each calibre, depending on the sectional density of the bullet used. The chemical composition of many of these powders is identical, the ballistic qualities depending on the thickness and density of the grain, which in turn depends on the method of compression and formation."

"The manufacture of smokeless powder can be divided theoretically into six operations: 1. Preparation of pyroxyl selected; 2, solution of the pyroxyl by a proper solvent; 3, compression; 4, lamination; 5, cutting; 6, drying."

"The following conditions are enjoined, under published advertisement, wherever smokeless powders are to be provided for service cartridges:

"1. The powder must be practically smokeless.

"2. It must not unduly corrode the barrel or cartridge case.

"3. It must not require an unduly strong primer for ignition.

"4. It must leave no hard, adherent, residue in the bore, especially after rapid firing, nor any metallic residue due to action of heat on bullet or barrel.

"5. It must not be sensitive to friction or shock.

"6 It must not be so friable as to endanger breakage of grains in transportation incident to service.

"7. It must not contain ingredients known to be unsuitable to form a safe and reasonably stable compound.

"8. It must admit of machine loading, with the machines in use or such as can be readily provided, the variation in each charge not to exceed 0.3 of a grain from the desired charge of 50 consecutive machine-loaded cartridges.

"9. It must not show a tendency to agglomeration during storage. Powder which has not already been used in the manufacture of cartridges and which shall be found defective in this respect, will be returned to the makers at their expense and deliveries of the powder under contract will be suspended.

"10. Other things being equal, that powder which produces the least heating on the barrel is preferred."

CALIBRES.

The Military Information Division, War Department, Adjutant-General's Office notes (No. 8), of 1896 series, shows that the smaller States, which have but recently armed their in-

fantry, have adopted smaller calibres than the great military powers, whose armament antedates the former by several years. Should calibres of smaller dimensions prove a decisive superiority over those now employed by Germany (7.9 mm.), France (8 mm.), and Russia (7.62 mm.), etc., nothing, of course, will be allowed by these nations to stand in the way of a rearmament with the most approved infantry weapons.

"How far further reduction in calibre will go it is impossible to foretell at this time, but it may be stated that voices from various quarters begin to make themselves heard against any further reduction of calibre."

It has been held, and not incorrectly, by those who favor the reduction of a calibre to the lowest practicable figure, that with troops equally skilled and disciplined, but differently armed, the number of adversaries struck must increase with the number of cartridges carried, and that, other things being equal, the force of an extended line will depend much more on the number of cartridges carried per man than on the rapidity of fire possible. If this be so, the useful effect which can be obtained by an organization must depend largely on the weight of the cartridges; a consideration which invites reduction of calibre to the extreme limit of effectiveness.

The whole controversy hinges upon this term, "effectiveness," and whenever it shall be satisfactorily demonstrated that the "stopping effect* " shall be as good for diminutive calibres as it is for those of the medium standards, then will England, 7.7 mm.; Germany, 7.9 mm.; Russia, 7.62 mm.; France, 8 mm.; Turkey, 7.65 mm.; Austria-Hungary, 8 mm.; Belgium, 7.65 mm.; Denmark, 8 mm.; Portugal, 8 mm.; Argentina, 7.65 mm.; Peru, 8 mm., and last, but not least, the United States, 7.62 mm., be quick to follow the lead of Holland, Italy, Roumania, Spain, and Mexico, which latter group has adopted the 6.5 to 7 mm. calibre.

While the weight of the bullet has been reduced for the smaller calibres to gain velocity and multiply shots, it is true nevertheless that reduction in weight of bullets must not be carried to a point entailing a sacrifice of the "sectional density," since such sacrifice is well calculated to offset from the ballistic standpoint

* We use the term "effectiveness" always in this sense of the word.

other and more apparent advantages incident to the reduction in weight of cartridge as a whole. By "sectional density" is meant a fixed ratio between the area of cross section and the weight of bullet, and is reckoned in the case of small-arms, as has before been stated, at 3000 grains per inch area of cross section.

OBJECT OF SMOKELESS POWDERS.

The Ordnance Department has made a strenuous effort for the past six years to procure a smokeless powder for the calibre .45 Springfield rifle, but until this time without avail.

The object in this instance has been to attain the condition of *smokelessness* rather than with an expectation of improving the ballistic properties of the arm. Indeed, no additional muzzle velocity can be imparted to the .45 calibre bullet without overtaxing the shoulder of the firer under the shock of recoil.*

It may be stated in a general way that flatness of trajectory and increased range for modern small-arms is effected by reduction in the calibre and weight of projectile. At first the force necessary to impart a requisite velocity, was secured by the agency of a compressed black or smoky powder charge.

The expedient of a compressed powder charge, rendered necessary to avoid disproportioned length of cartridge and powder chamber, was followed in natural order of sequence by the bottle form of cartridge, but the effort of the chemist was more especially directed to the production of some compound, the bulk of which should be materially less than that of the black powder charge essential to produce the desired force.

It was found that such compounds, or more properly speaking, mixtures of ingredients, in themselves chemical compounds, were converted almost, if not wholly, to gas and with a minimum of smoke. This smokelessness, strange as it may appear, was but an incident in the development of the new powders, and to the surprise of the chemist has become, as it were, a matter of prime importance, but, nevertheless, it has not, until of late, been a *determining factor* in the selection of smokeless powders for the small-arm service.

* As we pass below the .45 calibre, shock of recoil is not the limiting condition in determining a projectile's velocity. It has now become a question of the resistance of the breech mechanism under the high gas pressures in small calibre rifles.

The real or principal object of this search for so-called smokeless powder has been the attainment of a substitute compound for black or ordinary gunpowder, which should occupy much less volume in the powder chamber of the rifle than that of a black powder charge required to produce the requisite velocity.

If we are to profit by the opinions of those actually engaged in the Santiago campaign, it should follow that ordinary gunpowder or "smoky powder," lately so called, should be withdrawn from service, for reasons other than those herein specified.

In the controversies that have of late arisen, it should be fully understood, if it is not, that the Springfield rifle, calibre .45, with its black powder charge, was to all intents and purposes withdrawn from the service when the Regular army was supplied with the present magazine rifle and smokeless powder cartridge. It was the expressed intention of the authorities, temporarily and for certain specified purposes, to retain the Springfield for the National Guard, holding the magazine arms in the regular course of manufacture as a reserve supply for use by any volunteer forces called upon for service in the field, and as early as 1893 the manufacture of this rifle ceased.

Unfortunately Spain neglected to inform us of her intention to quarrel, and Congress refused to grant the appropriations for new arms, asked for from year to year since 1892; indeed, with the meagre annual appropriations it was only possible to obtain a supply of magazine guns for the Regular army and smokeless powder cartridges sufficient for the annual target practice of a fraction of our small army, allowing we may say about two cartridges per day per man, and with no reserve.*

As to the use of smokeless powder in the Springfield .45 calibre rifle, the fact is known that its pressures run very high in small arms, frequently exceeding 40,000 pounds per square inch in our army magazine rifle, and in the lesser calibres 50,000, 60,000, and even 70,000 pounds per square inch. It is only by dint of supreme effort, and after years of careful and exhaustive experiments, that a smokeless powder has at last been found suitable for the .45 calibre Springfield rifle; one which may not overtax a breech mechanism, calculated originally

* This is the plight in which we have lately been caught; an embarrassment anticipated by the Chief of Ordnance as far back as 1893. (See annual reports).

to resist a pressure of not more than 24,000 pounds per square inch. An increase of the black powder charge (70 grains) now used, by about 10 grains, will exceed the safety limit in the Springfield, although the pressures due to the use of black powder in this arm are moderate and uniform. We use this word "uniform" advisedly, as it is a well-established fact that pressures due to the use of smokeless powder in small-arm rifles under certain and not very abnormal circumstances, are quite variable; in fact, we may say that at times they are treacherously inconsistent, and demand an exceeding stable and positively resisting breech block, something akin to that of the Sharps rifle or bolt system.*

The Chief of Ordnance, in his annual report for 1898, says: "The very serious objection to the Springfield rifle in its limited use by the small number of troops armed with it at the battles in the vicinity of Santiago was the fact that it was not supplied with smokeless powder cartridges."

"In fact, all the criticisms, both official and semi-official, by officers, which have reached me, are confined to this one point, and it is possible this fact only has caused the hasty condemnation of the arm."

He further maintains that "this disadvantage is not inherent in the arm," and says emphatically that statements "by officers of high rank," to the effect "that the Ordnance Department considers the Springfield rifle the equal of the magazine rifle," are "not true," and that "the onslaught based on this statement is unfair and unjust."

A possible reason for these statements, he says, may be "that the officers of the Department, in answering attacks made upon the Springfield rifle, have cited the well-known fact that for many years after the adoption of the magazine rifle, officers—excellent officers—of both our infantry and cavalry have claimed that the Springfield rifle was much the better arm of the two."

In line with this argument, the writer's attention was invited some time since, to extracts from official reports wherein it was made to appear that the new .30 calibre rifle bullet, while more accurate at the moderate range of 500 yards, was less so

* This may be news for the "users of the arm," and render them less severe in their criticism of the Ordnance Department.

at and beyond the range of 1000 yards than its predecessor, the .45 calibre rifle bullet.

By way of testing this assertion, a practical test was made in a 3 to 6 o'clock wind, assimilating a 1000 range over the 500-yard space with reduced powder charges, and with results indicated in the following record (a limited test and therefore by no means conclusive):

Conditions of special test (fixed rest).
Wind 3 to 6 o'clock, 32 miles per hour.

″.30 calibre 220 grains bullet, normal charge 38.6 grains smokeless powder, 500 yards range—mean radius (20 shots) from centre of impact	′.70
″.30 calibre 220 grains bullet, reduced charge 22 grains smokeless powder, 500 yards range—mean radius (30 shots) from centre of impact	′.93
Assimilated 1000 yards range *	1′.63
Time of flight, 2 1-5 seconds.	

″.45 calibre 500 grains bullet, normal charge 68.6 grains black powder, 500 yards range—mean radius (20 shots) from centre of impact	′.75
″.45 calibre 500 grains bullet, reduced charge 32 grains black powder, 500 yards range—mean radius (20 shots) from centre of impact	1′.27
Assimilated 1000 yards range	2′.02
Time of flight, 3 1-5 seconds.	

Experiments tending to throw more light on this subject are referred to in the Chief of Ordnance's report for 1897, wherein he says:

"An interesting report is appended, of experiments made at the Frankford Arsenal, to determine the deviation of .30 and .45 calibre rifle bullets from wind pressure produced by artificial means. When the two bullets suspended as pendulums were exposed to the same blast of wind for a period of time, the .30 calibre bullet was deflected more than the .45 calibre. But when the shorter time of flight for the .30 calibre, for a given range is considered, it appears that the bullet should be less deflected by the wind than the .45 calibre bullet in practical firings. The deductions from the experiments are that the deviation of the .30 calibre bullet due to the wind should be about two-thirds that of the .45 calibre at 200 yards range, with in-

* It is stated on the best authority, that under the most favorable conditions twelve (12) hits were made on a target 20 × 30 feet, at the range of 2000 yards. This was done with the .30 calibre rifle, and it is not improbable that the same practice with the .45 calibre would be equally as good.

creasing proportions up to about nine-tenths that of the .45 calibre at 2000 yards range. The results cannot be taken as a true representation of the effect of wind upon the same projectile in actual flight, for the circumstances are different, but are instructive and useful for comparison, since a correct determination of the wind effect by direct experiments in actual firing is, as is well known, very difficult of accomplishment."

Lieut. I. H. Parker, 13th U. S. Infantry, in his official report as commander of the Gatling gun battery at Santiago, says:

"Tactically, the war in Cuba was marked by the total absence of drill manœuvres. The grand tactics of the battle, as planned by the general were superb. The orders issued contemplated effective use of the artillery, which was to open at daylight. The preparation for the assault by artillery fire, however, failed to materialize. The artillery could not live at ranges near enough to see the Spanish trenches nor do effective work upon them at long ranges. It was demonstrated by noon *that the modern rifle has moved artillery back on the battle-field to 1500 yards.*" (The italics are ours.)

By "*modern rifle*" it is presumed the Spanish Mauser or U. S. magazine rifle is meant. The danger zones for the Mauser, the U. S. magazine and the Springfield rifle are as 44, 40 and 28 feet respectively, at the mile range and with impact energies in an inverse ratio, 152, 175 and 290 foot pounds. Since this is the case why should "1500 yards" be considered an undesirable or ineffective range for the modern field-gun which latter must of course, out class the small-arm.

We have endeavored to confine ourselves to general principles, disregarding special and exceptional conditions, but if anything should qualify Lieutenant Parker's views on the inefficiency of light artillery, it will be found in an extract from the *Army and Navy Journal*, of Nov. 19, 1898, wherein it is said "that the artillery had the opportunity of their lives at the battle of Omdurman, and the butcher's bill of that engagement shows how well they improved it, testing the effect of shrapnel on living men as it has never been done before. All the conditions favored the artillery—fanatical Dervishes charging in mass over an almost perfectly level and smooth plain, containing not even vegetation, beyond a few tufts of grass.

There was absolutely no cover and the enemy were exposed from first to last to the fire of shrapnel from three field batteries and one horse battery, each firing 500 rounds, one nearly 1000 rounds. The field batteries began firing at *1700 yards*, and in face of their heavy fire, and that of the small-arms and Maxims, the Dervishes pushed their assault up to 400 yards, one body of forty horsemen actually galloping to within 350 yards before they were annihilated by the cross-fire of the four batteries and the infantry and Maxims. No large unbroken body of men came nearer than 800 yards. Isolated groups struggled on, but the great wave was stayed *by the terrible shrapnel fire before it approached within 900 yards.* At about 600 yards range the three field batteries opened with "case" and kept this up to 400 yards, some minutes, each battery firing some 80 rounds of case. L. Oppenheim, who tells this story more at length in the *United Service Magazine* for November, after the engagement, found the Dervish dead lying in countless heaps in front of the battery line of fire. The batteries changed front several times, and on another front, which was open to a greater distance, *two of the batteries opened on the enemy at 3000 yards' rauge*, while a gunboat, stationed to protect the right rear, enfiladed them at long range. Here the attack was repulsed with such fearful loss to the enemy that they retired before the infantry or Maxims had fired a single round. *The Dervishes never approached within 2000 yards on this side and retired, leaving about 1300* bodies on the field, by actual count, three days after the battle." (The italics are ours.)

Indeed the general impression has been that owing to the effectiveness of the modern field-gun at extended ranges, employing shrapnel fire, the reduction of weight and calibre of the small-arm projectile was a forced condition to restore an equilibrum destroyed.

While therefore we are not impressed by certain views expressed by Lieutenant Parker we are nevertheless in entire accord with him in the value he attaches to the modern machine.

To return from this digression, the Chief of Ordnance, in his report before referred to, expresses himself to the effect that "Much has been said inconsiderately of the (supposed) short range of the Springfield. Its extreme range—2 miles—is prac-

tically the same as that of the magazine rifle; and at this range the shock or blow from the bullet is greater than that of the lighter bullet of the magazine rifle—a matter of importance in long-range firing." In fact as appears from Table I, its energy, or "efficiency," is greater at all ranges.*

The table further shows that the now adopted 112-grain defective sectional density bullet for the navy, "to gain velocity and increased penetration at short or moderate ranges," falls off in velocity and in energy, surprisingly when compared with the proper sectional density bullet (135 grains) for which the sights of the arm (as we are told by a marine officer) were originally graded. Why this sudden change of base? Is it really to give the arm a better status for "efficiency" as ganged by a record of *muzzle penetration*, or are there other reasons?

The *Army and Navy Journal*, in its editorial of the 23d of June, 1898, makes an observation on this subject, suggesting that the lesser weight and length of bullet may have been employed *to relieve the mechanism of the arm*, in which view we find that the *Journal* is sustained by the following from page 171 of "A Year's Naval Progress, July, 189?": "There have been rumors that high pressures (58,000 pounds per square inch) cause injury to the piece when a few thousand shots have been fired, viz., jogging of the breech-bolt, breaking of the extractor, deterioration of barrel, etc., and that to reduce this pressure the powder room in the shell is to be increased, involving alteration in the gun to take it. Confirmation of this rumor has not reached this office."

From a knowledge of some of the difficulties of the case we apprehend that pressures with the 135-grain bullet may have been found to range nearer 70,000 than 58,000 pounds per square inch.

ABSENCE OF SMOKE.

We need not be reminded that "the absence of smoke from

* Energy computations are a better gauge of "efficiency" than penetration records. For instance a lead bullet, .45 calibre weighing 230 grains with 2000 feet second velocity deeply indented an iron plate and passed through but 11 inches of pine plank; whereas a 405 grain bullet with normal velocity 1300 feet second made no impression on the plate and yet passed through 18 inches of pine plank. The high velocity distorted the bullet and destroyed its penetrative capacity.

the field of battle cannot change any principle of tactics, since it is but a covering or screen, differing from that given by natural objects only in the fact that it is impossible to avoid it when it becomes hurtful. This absence of smoke emphasizes the principle of 'seeing and not being seen'; since it renders the realization more possible. Smoke gives cover for manœuvres and so lessens losses; it makes feasible the replenishing of ammunition, and even sometimes, by concealing losses, sustains the morale of the troops."

"The meaning of all this is that the morale plays a great part in all battle-fields, and that all tactics must take it into grave consideration." It is claimed that the absence of smoke will allow troops to see comrades fall and their commanders taken away, and hence will lower their morale. On the other hand, it cannot be doubted that if smokeless powders be employed by all arms of the service that the field will be cleared for skillful action. "The professional swordsman and amateur are on the same level when blindfolded and using crude weapons; uncover their eyes and give them good weapons and the conditions are changed."

Lieut. H. C. Davis, Third United States Artillery, from whom we have taken the liberty to quote, further says, in speaking on this subject of smokeless powders in their application for light artillery service:

"The battery is a better target than formerly, but as it is in more danger when coming into action than after it opens fire, and as it makes no smoke before firing, the advantage of smoke as a covering disappears, especially so when considered in connection with its subsequent blinding effect on the gunners."

"Being a better target, artillery must now doubtless endeavor to obtain all shelter compatible with its efficiency in firing. This means a more intelligent reconnaissance of the whole field, especially as to all possible artillery positions. Batteries must not run the risk, unnecessarily, of coming into action at points exposed to fire, possibly from unseen guns or skirmishers."

"Absence of smoke will enable a battery to take a covered position and fire away for some time without its position being discovered. It has been suggested, as necessary to discover the position of such a battery, that the direction of shot furrows be

noted. Though not practical, this indicates that fire from unseen batteries is expected in the future."

"Without smoke we shall not, as at Sadowa, hear of infantry advancing, unseen, to such short range that the artillery, unable to defend itself, is captured."

DESIGNATION OF SMALL-ARMS.

Returning from this digression, it should be understood that the ballistic properties of the several rifle calibres are independent of the type or kind of breech mechanism of specific systems. In fact, the effort has been, in the conduct of tests of various magazine systems, to bring the arms to the same calibre. In the matter of the designation of small-arms, a word here is in order. The Russian system has been denominated "The Russian Rifle," the German arm "The German Infantry Rifle," and the United States 30-calibre arm as the "United States Magazine Rifle." Other countries have adopted a more specific classification, such as "The Belgian Mauser," "The Spanish Mauser," "The Danish Krag-Jorgensen," "The Austrian Mannlicher," "The Roumanian Mannlicher," etc., but a majority of these and other modern magazine small-arms may be brought under the more generic classification of "The Prussian Bolt-American-Lee Magazine System."

Mr. James Lee, an American inventor, has the credit of having presented to the statutory magazine board of 1878* a magazine rifle differing radically from all other rifles of that class. In lieu of the tube underlying the barrel or encased in the stock or butt and carrying a column of cartridges, he proposed a magazine either fixed or detachable, placed below the receiver and in front of the guard, the rear portion of the receiver being cut away in order that the cartridge should enter from below. The latter were led up by springs at the bottom of the magazine, retaining their parallelism with the bolt until they came into line with the axis of the bore, when they were forced by the bolt into the rifle chamber. Each magazine carried five cartridges. If required to be detachable, they could be cheaply made of sheet metal, to be thrown away after the cartridges were fired. In

* At the time Mr. Lee's invention was received with favor and the board was much disappointed not to have been able to test the principle, as the Lee gun was in crude shape and not ready for the prescribed tests.

this we recognize the principle of construction at present embodied in many of the most notable foreign small-arms, and not only has our American inventor's name been omitted in the designation of arms of this type, but they come back to us under foreign titles, such as "Krag-Jorgensen," Mauser, Mannlicher, etc.

MAGAZINE ARMS—SINGLE LOADERS.

The report of the board * of 1890–92 was made after an examination of 53 guns presented by American and foreign inventors, many of the guns being the adopted arms of the principal military powers of Europe. The model known as the Krag-Jorgensen No. 5 was selected "as possessing the best magazine system and as a suitable and satisfactory system to be adopted for the service." This arm could be used as a single loader, and as a single loader the board found that "it was the best arm that was presented." This recommendation at the hands of the United States army board carried with it great weight, in view of the fact that the Springfield 45 calibre rifle, then so much in favor in our service (in the reduced or required calibre 30), was tested in competition with the Krag-Jorgensen used as a single loader.

In this connection it should be understood that when a

* "The adoption of this rifle and carbine for army use was the result of a long series of tests of arms presented to a board of officers, appointed by General Orders, No. 136, Headquarters of the Army, Adjutant-General's Office, November 24, 1890, to 'consider and recommend a suitable magazine system for rifles and carbines for the military service.'

"The composition of the board was changed by several subsequent orders. Its members, at the date of the final report, were :

Lieut.-Col. R. H. Hall, Sixth Infantry.
Lieut.-Col. J. P. Farley, Ordnance Department.
Major H. B. Freeman, Sixteenth Infantry.
Captain S. E. Blunt, Ordnance Department, recorder.
Captain G. S. Anderson, Sixth Cavalry.

"The board in its report of August 19, 1892, recommended the arm now known as the U. S. magazine rifle, model 1892. This action was approved by the Secretary of War on September 15, 1892.

"The details of calibre, rifling, bayonet, sights, and other minor parts, and ammunition adopted, were recommended by a board of ordnance officers appointed by the War Department September 22, 1892."

Revue Militaire d'Etranger in its issue for September, 1893, in referring to the Commission appointed in Norway to select a magazine rifle for its service says : "After having fixed the general dimensions of the arm, it passed to the consideration of the mechanism and the question of the magazine. The most

magazine arm is said to be "employed as a single loader" its magazine reserve supply at the time is "cut off" by a mechanical device attached to the gun, something in the nature of a thumb or finger latch, which can be operated with facility in the adjustment of the magazine feed. Neither the Belgian nor the Spanish Mauser rifles, which are classed as of the "repeating" type of magazine arms, are well adapted for single fire, since the "clip" supply of ammunition, in groups of five each, is inconvenient for this purpose, and to this extent restricts the employment of such arms to that of magazine fire. Magazine fire induces a useless waste of ammunition, for the simple reason that, if there has been entered in the magazine of the rifle a

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recent types of arms, Danish Krag-Jorgensen, Austrian Mannlicher, Portuguese Kropatschek, German Mauser from Spandau, Belgian Nagant, English Lee-Speed, Swiss Schmidt, Marga, etc., were submitted to comparative tests in consequence of which the commission decided to only put in competition the Krag-Jorgensen, Mannlicher and Mauser. These three arms were submitted to tests of every kind. The question of safety of the mechanism, rapidity of aimed fire, either as magazine arm or single loader, with its magazine charged or not, rapidity of unaimed fire, resistance of the system to dust, rust, resistance to excessive charges giving very high pressures (5000 atmospheres), and to accidents arising from defects in the cartridges, were the object of successive inquiries, as a result of which the preference was given to the Krag-Jorgensen for the following reasons:

This arm is excellent either as a single loader or magazine arm, and can always be used even in case of damages to the magazine system. The magazine can be charged and recharged, the arm being loaded and completely ready to fire. Where in use as a single loader, the magazine remains intact and there are always available 5 cartridges which have been placed in it, whereas in the Mauser this number is reduced to 4. As to the Mannlicher, it is not susceptible of being employed under the same conditions.

Finally, a capital advantage, with the Krag-Jorgensen the loading of the magazine is done without effort, whatever the position of the firer, while with the Mauser and Mannlicher the firer is obliged to exert a certain force and expose himself slightly if he is lying down. The mechanism of the Krag Jorgensen rifle works, besides, with the greatest certainty, is easily cleaned, and its manual does not exact, so to speak, exercises beforehand. It is no longer necessary to have a charger to refill the magazine.

The rifle is furnished with a short bayonet with steel fastening. The sight is graduated every fifty metres up to 1000 metres and every 100 metres up to 2200 metres.

The weight of the arm is from 4 kilogrammes (8.82 lbs.) without its bayonet to 4.240 kilogrammes (9.35 lbs.) with the latter; that of the cartridge is 23.5 grammes (363 grains). The soldiers will receive cartridge boxes capable of holding 150 cartridges which correspond to a weight of about 4 kilogrammes (8.82 lbs.)."

"clip" containing, say five cartridges, the soldier will be tempted after the first or second shot to needlessly fire away the remaining or partial supply in the magazine, so that he may at all times carry his weapon in its most effective condition, that is, with a full complement of cartridges in the magazine.

Partially filled magazines cannot well be replenished except by breaking the clip contents, and as broken clips are objectional, or inconvenient, to say the least, it is clear that a troop employing the clip supply will soon acquire the habit of firing with needless rapidity to no good purpose, and with useless waste of ammunition. If it be considered that the difficult problem of ammunition supply has not as yet been solved, even where we have the best disciplined armies, it will be seen that in countries like ours, resting dependence upon hastily extemporized levies wherein "fire discipline" is next to impossible, the repeater type of magazine arm has no place, whatever may be claimed in its favor where disciplined troops are concerned. It is true that for a period probably exceeding 90 per cent. of the whole time in which a force is actually engaged on the field of battle, that a certain deliberation and care should be taken in directing its fire. With the modern long range and accurate shooting rifles marksmanship is at a premium, and therefore it is that arms capable of running out the normal supply of ammunition carried by the soldier, in five or six minutes, cannot be favored, except where "fire discipline" can be enforced.

For this reason a magazine arm with a "cut-off" ordinarily used as a single loaded and single firer, is the arm best adapted for our service.* Such weapon we have in the U. S. magazine rifle model 1896.

If, then, the United States service rifle is recognized as

* From what the Chief of Ordnance has to say on the subject of single loading and single fire it is clear that he believes, and we know as well that a large majority of the officers of our service prefer the magazine "cut-off" gun to the so-called repeater type and for the reasons which are stated in the Chief's report.

He says: "Stress has been laid upon the fact that the magazine arm could be fired more rapidly than the Springfield. As the latter can be fired fourteen rounds per minute, and as a soldier who fires efficiently to hit in battle must determine the range, set his sight, select the object to be fired at, and take correct aim, and cannot therefore usually fire more than one round per minute, this is matter of minor importance. That is, the arm can be fired, say, ten times as fast as it should be fired in battle if efficiency and execution are properly at-

the best single loader extant, while it is equally efficient when operated as a magazine rifle to that of any other arm, it will be interesting to briefly note the results of comparative tests made with it and other rifles of prominence, at this time.

RIFLES COMPARED.

Comparing the Belgian Mauser, calibre 30, and the Danish Krag-Jorgensen, in modified form constituting the service weapons of the Spanish and United States armies, it has been found that 20 shots can be fired with a good degree of accuracy from either arm in about 54 seconds, and that fired at will, that is, without aiming, 20 shots can be fired in near about 40 seconds. The continuity of fire from either of these arms, used as single loaders (broken clips in the Mauser) was also illustrated by firing 40 shots with a good degree of accuracy in two minutes.

The above time tests repeated under conditions of magazine fire, which includes the time required to replenish magazines as emptied, showed a continuity of fire for the above noted number of cartridges fired not to exceed in rate of fire that of the same arms used as single loaders, and in the manner specified. The arm to which we have referred as the Belgian Mauser differs from the Spanish Mauser in respect to calibre and weight of bullet, the former as tested having been brought to the calibre 30, and employing a 220-grain bullet as against the 275 calibre and 177-grain bullet for the Spanish rifle.

RECOIL.

It has been fully demonstrated that the comparative maximum free recoil of the .45 calibre Springfield rifle, is 19.84 foot pounds energy for black or ordinary gunpowder as against 17.06 foot pounds for smokeless powder, where the 500 grain bullet has been employed and a muzzle velocity of 1279 feet per second has been imparted to the projectile.

Substituting in the formula

$$W_1 V_1 = mv + A p$$

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tended to. The time required for charging the magazine leaves the magazine rifle no material superiority in this respect. The advantage of the magazine arm in respect to rapidity of fire consists in the fact that there are always five cartridges in the magazine which can be fired more quickly than five shots from the single loader, should occasion make this necessary. Such occasions are exceedingly rare."

for p, the powder charge, 68 grains of black powder, or for the same member of the second term 29 grains of smokeless powder and for A the determined coefficients 2258 and 3236 respectively, the ratio of recoil energies of black and smokeless powders has been found for general and practical purposes to be as 1.18 to 1. This ratio also stands at or about 1.13 to 1 on the dynamometer which with its attached spindle increased the recoiling mass by 60 per cent.

If therefore the breech mechanism of the Springfield rifle will endure the pressure due to a charge of smokeless powder capable of imparting a velocity of 1360 to 1400 feet per second to its projectile, the shoulder of the firer will not be overtaxed by shock of recoil.

The computed ballistic results in Table I., relating to the .45 calibre, are made upon the basis of a somewhat high muzzle velocity and should be discounted by about 5 per cent. for the normal black powder charge. The above remark, "endure the pressure," should be qualified by the term *variation* of pressure, as it is fully understood as has before been stated, that exceptionally high pressures, far beyond the standard, result oftentimes in the use of smokeless powders from unexplained and unaccountable causes. In the .30 calibre rifle great advantage in practice for accurracy results from the fact that its lesser weight of bullet in spite of its increment of velocity indicates for this rifle, measured by the dynamometer, 50 per cent. less recoil than is allowed for the .45 calibre rifle and hence the nerve of the firer is less disturbed and his shooting proportionately improved.

It has been suggested that if a "low pressure long sustained," for any powders tested could be realized, as against a more sudden and less sustained pressure with powders in ordinary use, then the time in which the shoulder of the firer must absorb a given energy of recoil would be greater, the effect would be less like that of a blow, and the shock correspondingly ameliorated. Thus, although an equal muzzle velocity may be communicated to the projectile in the same gun by different powders, that powder by which the highest acceleration of velocity is produced in the projectile in its passage through the bore should give the greatest sensation of shock, since corre-

spondingly sudden changes would be produced in the velocity of recoil of the rifle resting in contact with the shoulder of the firer. The action of such a powder would be characterized by a relatively high pressure suddenly developed, and then falling off rapidly towards the muzzle. On the other hand, the least possible sensation of shock should be produced by a powder giving pressures so regulated as to cause the projectile velocity to be uniformly accelerated from seat to muzzle.

These views were advanced in support of what might be claimed for a suitable powder in the way of ameliorating the shock of recoil against the shoulder of the firer; *they are aside from the question of maximum recoil energy as usually computed*, or *the total work of recoil as measured by the dynamometer.*

That the rifleite and S. R. powders, however, do not possess this property to any greater degree than a number of other powders has been demonstrated, and at the same time the reason of the greatly reduced recoil of the .30 calibre rifle as compared with the .45 calibre made apparent.

To elucidate the question required a consideration of the forward motion of the projectile (with its powder charge) from its seat in the chamber of the rifle and the simultaneous motion of the rifle; the quantity of such motion at each and every point of the path of projectile in the bore being the same for the gun on the one hand and the projectile, with its unconsumed powder charge, on the other.

The relations are expressed in Plates VI. and VII.

The best that could be anticipated for a minimum recoil powder would be a maximum pressure not exceeding that of the *mean pressure* for the path (barrel length) over which it works. In such case the sensation of shock* upon the nervous system of the firer should be ameliorated and the acceleration of velocity of the projectile in the bore correspondingly modified (see curves B and E plates VI and VII).

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* From data at hand, derived from exaggerated velocity curves D and H, Plate VII., the mean ordinate of these apparently coincident curves shows that the .45 calibre 500-grain bullet passes with a portion of unconsumed powder charge through the bore of the rifle from its seat in the chamber to the muzzle (in this case 2.6 feet) at the rate of about 900 feet per second.

A more exact measure of this velocity obtained with Dunn's Photo-Velocimeter, indicated the projectile velocity to be at the rate of 972 feet per second

The parabolic curves B and E, express by their ordinates the velocity of projectile in the bore of rifle under the hypothesis of uniform pressure, but the curves A and G, D and H show that in practice this condition is very far from realization and that no small-arms smokeless powder so far tested possesses any advantage over black powder, in this matter of acceleration of projectile from seat to muzzle of rifle.

The plate on next page represents the smoke from powder charge which is visible to the naked eye, but the photograph takes cognizance of the powder gas *which is invisible.* The hemispherical volume of gas in rear of the smoke, and in contact with the muzzle of the gun, operates to increase the velocity of projectile after it has passed from the bore, and the reaction on the bottom of the bore due to pressure on projectile base and the atmosphere, increases the recoil of the gun. Variable

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for a similar path (2.43 feet) the time elapsing for this distance travelled being .002518 of a second. Captain Dunn qualifies his record of actual measurement by the observation that in order "To obtain approximately the time from origin to first spark recorded, recourse was had to data given in Table II. and IV. of Colonel Farley's report, published in the Report of the Chief of Ordnance, 1893," and to which report the attention of the reader is invited, for further information on this subject, also to the succeeding report of Captain Dunn published in "Notes on Construction of Ordnance No. 74 of Jan. 3, 1898."

It is quite clear that from the foregoing data, the rifle should recoil over a space of .25 inch while the bullet is in the bore and with a mean rate of velocity of 8.6 feet per second, the mean energy of recoil being about 18 foot-pounds. The maximum velocity of projectile and energy of recoil, 20 foot-pounds for the black powder, will then follow as the bullet passes over the first interval of twenty feet from the rifle's muzzle, for reasons before stated. We may accept the ratio of maximum recoil energy 1.18 to 1 for black and smokeless powders for the *disconnected* system, *as a ratio* holding good for the energy of recoil of the connected system; and from this we may infer that the .45 calibre bullet with its *smokeless powder charge* develops an energy of recoil of 15 foot-pounds in its passage through the bore, from seat to muzzle, as against the determined energy of recoil (18 foot pounds) where the black powder charge has been used.

We may also observe, that should a powder be discovered which shall show a maximum pressure in the chamber of the rifle, not exceeding the mean pressure for the path over which it works, corresponding to the muzzle energy of projectile, the (parabolic) velocity curve (G, Plate VII.), will in that case represent, by its mean ordinate, the mean velocity of projectile in passing along the bore, something near about 80 per cent. of that of the mean velocity of the powders tested. This might reduce the shock slightly but not *appreciably*, and the measure of the full effect of the blow on the shoulder which succeeds the initial motion (.25 inch) must develop when the *maximum* energy and velocity of projectile is attained.

powders imparting equal *muzzle* velocities to the same projectile, operate unequally in this regard and to this extent make the coefficient "A" a *variable constant* determinate for each particular case.

MINIMUM CALIBRE BULLETS.

Kocker in his pamphlet on the subject, "Improvements in Rifle Bullets from the Standpoint of Humanity," argues that if

PHOTO SHOWING HEMISPHERE OF POWDER GAS INVISIBLE TO THE EYE.

the object "of modern weapons be only to place the enemy *hors de combat*, then the arms of the present day exceed their requirements."

Modern bullets, he says, really become explosive bullets at moderate ranges, that is, explosive in effect, due to their high velocity, and since this velocity cannot be lessened without the sacrifice of this, the very purpose of their introduction, the anti-humanitarian effects should be compensated :

1. By reducing the calibre from 6.5 mm. to 5 mm.
2. By increasing the hardness of the point (steel).

3. By sharpening the point of the bullet to produce easier penetration.

4. By increasing the velocity of rotation of bullet to reduce tumbling.

It is worthy of observation that we have passed from the calibre of the early sixties, through a descending scale of .70, .58, .50, .45 and .30-inch, and entered the contest of to-day with an adversary provided with even a lesser calibre than our own .275-inch as against .30-inch.

From what goes before and from such experience as has been derived in the Spanish-American war it is thought that we may have done well in restricting the reduction of our service calibre to the .30 limit. This view is further confirmed by the fact that in the English service the "Dum-Dum," or "mushroom bullet," has been introduced for the minor calibres to increase their stopping effect in warfare waged against savages. This has been found necessary even with the .31 calibre, 230 grain bullet.

PENETRATION.

Abstract of penetration tests of calibre .30 bullets, at 500 yards range.

Substances, etc.	Corrected mean penetrations, inches.
Oak (green and not of best quality); and soft white pine boards (green and not of best quality), 1″ apart, transversely to fibres.	5.3 oak and 5.5 pine.
Solid oak block, 12″ thick	6.5
Solid pine blocks, 20″ thick.	21.66
Solid pine blocks, 16″ thick, and 1″ pine boards 1″ apart.	19.27
Brick wall, 9″ thick, 25″ × 21″.5 face	1.38
Moist sand, loose	18.50
Loam, loose.	23.64
Coarse gravel, loose.	11.80
Sand and loam, one half each, loose.	18.80
Clay, loose	22.60
Clay and loam, one half each, loose.	22.60

PLATES AND TABLES.

Plate I.—Shows the initial of muzzle velocity of projectiles fired from the .45 and .30 calibre rifles for variation in the length of barrels, smokeless powder being the charge for the .30 calibre, and both smokeless and ordinary gunpowder the charge for the .45 calibre rifles.

Plate II.—Indicates in like manner, variation in velocities, due to variation in the weight of bullet.

Plate III.—Shows variation in velocity due to variation in powder charge.

Plate IV. and V., as well as Plate IX.—Represent trajectories of rifle projectiles, the latter plate accompanying the Table I., of computed elements of trajectories.

Plates VI. and VII.—Represent the velocity and pressure curves for the bullet in passing from the seat of the charge to the muzzle of the rifle.

Table I. has been prepared by employing Ingalls' ballistic formulas and tables, in order that the comparative ballistic properties of the principal small-arm calibres may be in evidence, the ballistic coefficient nine-tenths (.9) being assumed in the computations for each projectile calibre.

Table II. has been prepared in order to show the proportions and relations, as far as is known, of the various explosive substances or chemical constituents of smokeless powders, such as nitrocellulose, nitroglycerine, nitrosaccharose, nitrobenzine, nitronapthaline, picric acid, etc. The various solvents, such as sulphuric ether, ethyl acetate, acetone, etc., and the retainers, camphor, paraffine, stearine, benzine, acetine, vaseline, etc., are also noted in the table.

This latter table, prepared some time since, is restricted to powders at the time undergoing tests.

INSTRUMENTAL VELOCITIES AT 53′ DUE TO VARIATION IN LENGTH OF BARREL. (See Plate I.)

Curve "*A B*"—Velocity 36 grains of Wetteren Powder—.45 cal. rifle and carbine.

Curve "*C D*"—Velocity with .30 cal. rifle for rifle and carbine length of bore.

The law which governs the ratio of velocities and length of bore corresponding thereto, for the .45 cal. rifle, may be summarized as follows: (Curve "*E F*")

Below 50 calibres length of barrel, the initial velocities decrease rapidly in a somewhat direct ratio with the decrease in length of bore, giving 1185 f.s. for the 22 inch carbine length and 704 f.s. for the 5 inch length.

Between 22 inches (carbine length) and 32.6 inches length (rifle), the velocities increase in a ratio of about 9 f.s. to the inch and beyond 32.6 inches and up to 92 inches length the increase is not greater than 1½ f.s. to the inch, whilst beyond that length at which the velocity is 1379 f.s. the velocity has no practical increase and falls off at 122 inches length of barrel to 1374 f.s.

The variation in velocities due to varying the length of the .30 cal. rifle barrel, is expressed by the curve "*C D*",

5″.6	barrel	giving	1218 f.s.	28″.6	barrel	giving	1901 f.s.
7″.6	"	"	1411 "	30″.6	"	"	1932 "
12″.6	"	"	1641 "	31″.6	"	"	1941 "
17″.6	"	"	1771 "	32″.6	"	"	1962 "
22″.6	"	"	1872 "				

INSTRUMENTAL VELOCITIES AT 53′ DUE TO VARIATION IN POWDER CHARGE. (See Plate III.)

Curve "*A B*" for service rifle cal. .45—Weight of ball 405 grains.

Curve "*C D*" for service rifle cal. .45—Weight of ball 500 grains.

Curve "*E F*" for experimental rifle cal. .30—Weight of ball 230 grains.

The initial velocity of the 500 grain .45 cal. bullet is 1280 to 1300 f.s. and for the .30 cal. 1990 to 2000 f.s. 20 grains of black powder with the 500 gr. .45 cal. bullet imparts a velocity of 620 f.s.; 40 gr., 919 f.s.; 60 gr., 1162 f.s.; 80 gr., 1368 f.s.; 100 gr., 1456 f.s.; 120 gr., 1450 f.s. Charges in excess of 120 gr. rather retard than increase the velocity.

20 grains of smokeless powder in the .30 cal. rifle imparts a velocity of 1035 f.s.; 25 gr., 1326 f.s.; 26 gr., 1439 f.s.; 28 gr., 1529 f.s.; 30 gr., 1670 f.s.; 32 gr., 1766 f.s.; 34 gr., 1887 f.s.; 36 gr., 1994 f.s.; 38 gr., 2099 f.s.

The law of increase in the two cases may be summed up as follows: For the .45 cal. rifle the increase in initial velocity with increase in charge of powder between limits of 20 and 40 gr. is in ratio of 17 feet to the grain, passing the 70 gr. charge or service limit, the increase is in ratio of 5 ft. to the gr. until

reaching a maximum of 1485 f.s. for 110 gr. charge, the velocity then decreases as the powder charge increases in a ratio of 1.5 ft. to the grain.

With the .30 cal. rifle the velocity increases in a direct ratio of 53 ft. to the gr. between limits of 20 and 38 gr.* and continues to increase in the same ratio to the limit of safe pressure.

INSTRUMENTAL VELOCITIES AT 53′ DUE TO VARIATION IN WEIGHT OF BULLET. (See Plate II.)

Curve "*A B*" for service rifle cal. .45, scaled up for powders 1893 (approximate).

Curve "*C D*" for experl. rifle cal. .30, charge 36 gr. Wetteren powder.

Variation in weight of bullet between limits of 200 and 800 grains for the .45 cal. decreases the velocity as the weight of bullet increases in the ratio of one foot to the grain, the limits being 1662 feet on the one hand for the 200 gr. bullet and 1073 feet on the other for the 800 gr. bullet. The ratio is expressed as follows:

200	grain	bullet,	1662 f. s.	450	grain	bullet,	1324 f. s.
230	"	"	1658 "	500	"	"	1286 "
250	"	"	1657 "	550	"	"	1250 "
300	"	"	1558 "	600	"	"	1210 "
350	"	"	1476 "	650	"	"	1180 "
375	"	"	1441 "	700	"	"	1149 "
405	"	"	1425 "	750	"	"	1118 "
425	"	"	1353 "	800	"	"	1073 "

Variation in weight of bullet between limits of 125 and 260 grains for the .30 cal. decreases the velocity as the weight of bullet increases in the ratio of 2.21 feet to the grain, the limits being 2209 f. s. on the one hand for the 125 grain bullet and 1910 f. s. on the other for the 260 gr. bullet. The ratio is expressed as follows.

125	grain	bullet,	2209 f. s.	215	grain	bullet,	1967 f. s.
150	"	"	2100 "	230	"	"	1952 "
175	"	"	2092 "	245	"	"	1904 "
200	"	"	2003 "	260	"	"	1910 "

*This is evolved from the mean of many observations. Single velocities for the same charge of smokeless powder frequently differ as much as 80 f.s. of 4 per cent., from which it will be seen that no very definite laws can as yet be determined, where smokeless powders are employed.

500 YARDS TRAJECTORIES. (Plate IV.)

Gun.	Wt. of Ball Grains.	I. V. F. S.	R. V. F. S.	Elevation.
Springfield cal. .45.	500	1301	873.54	1° 9′ 39″
Rubin " .295.	217	1800	1033	39′ 41″
Springfield " .30.	230	2000	1128.1	31′ 49″
Springfield " .30.	220	2000	1103	34′ 09″

1000 YARDS TRAJECTORIES. (Plate V.)

Gun.	Wt. of Ball Grains.	I. V. F. S.	R. V. F. S.	Elevation.
Springfield cal. .45	500	1301	676.17	2° 59′ 53″
Rubin " .295	217	1800	778	1° 57′ 01″
Springfield " .30	230	2000	823.16	1° 37′ 7″
Springfield " .30	220	2000	804	1° 40′ 42″

THE NEW BLANK CARTRIDGE.

The new blank cartridge is one, in which a charge of smokeless powder explodes the projectile before leaving the bore. It is simple, novel and safe. The bullet-shape missile is made of paper, fashioned at the point the same as a metal bullet, and is charged with five grains of smokeless powder, which explodes within the bore.

When the breech-loading Springfield rifle was in service, the manufacture of metallic blank cartridges was a comparatively easy and simple process. With the old muzzle-loading musket, in which plain paper cartridges were used, all that was necessary was to omit the "buck and ball," or the elongated bullet, tie up the end with a string, and the cartridge was a blank, easily used. With the Springfield breech-loader, for which metallic-case cartridges were provided, thick pasteboard wads were substituted for the bullet, thus changing the cartridge to a "blank." These wads unfortunately acted like light projectiles and inflicted painful wounds, within a moderate distance from the muzzle.

The introduction of the new .30-calibre magazine rifle revolutionized the cartridge in respect to weight, size and form, and forced upon the Ordnance Department the necessity of provid-

ing a blank cartridge which would function properly in the gun. The magazine guide of the new rifle would not perform its office, in the use of blanks, until there was placed in the end of each, an exact counterpart in form, of the metal bullet. The weight of the paper bullet was immaterial, but without a projecting point of precisely the same shape and size as the bullet the cartridge could not be fed out of the magazine and into the rifle chamber.

The bullet-shaped projectile which takes the place of a real bullet is made of paper rolled into a tube fashioned at the point the same as the metal bullet, and, is charged with five grains of smokeless powder, which explodes in conjunction with the five-grain propellant charge in the cartridge case, so that the paper of the bullet is torn to atoms before passing the muzzle.

A blank without paper bullets is also in use for single loading fire.

NOTE TO TABLE I. (See next page.)

"Danger zone" for infantry, as mentioned in the following tables, it should be understood, is the space in the falling branch of the trajectory, in which, if an infantry soldier be standing he may be hit in the head if at any one extremity of the zone, or in the foot if at the other extremity.

	Range, feet.		Danger zone.	Energy.
Spanish Mauser calibre .275 bullet weight, 177 grains. Approximate.	0	.....		1914.
	2640	.....	223.	300.
	5280	.....	44.	152.
	7920	.....	15.	70.
	9042	.....	10.	50.

The comparative merits of the U. S. magazine rifle (Krag-Jorgensen) and the Belgian Mauser, both of the same calibre have their ballistic properties shown in horizontal group 2, Table I. The Spanish Mauser differing from the Belgian Mauser in calibre and weight of bullet will be found to have its ballistic properties, a mean of the horizontal groups 2 and 4, Table I, with a close degree of approximation.

The above table is based on an estimate of this kind.

TABLE I.—Computed elements of trajectories, etc., for Army and Navy service and experimental bullets. (Ingalls' Tables and Formulas.)

	DESCRIPTION OF BULLET.	Weight, pound.	Diameter, inch.	Sectional density.	Coefficient of reduction.	Ballistic coefficient.	Altitude factor for ballistic coefficient.	Range, feet.	Muzzle and remaining velocity, foot-seconds.
1	Army bullet, cal. ″.45,	$\frac{500}{7000}$ = .071428	.45227	.3492	.9	.388		0	1360.
							0	2640	761 0
							1.0036	5280	510 8
							1.0181	7920	348 8
							1.0329	9042	300 0
2	Army service bullet, cal. ″.30, cupro-nickeled steel jacket.	$\frac{220}{7000}$ = .031428	.30	.3492	.9	.388		0	2000.
							0	2640	901 8
							1.0036	5280	599 5
							1.0145	7920	407 6
							1.0218	9042	347 9
3	Army experimental bullet, cal. ″.22, cupro-nickeled steel jacket.	$\frac{120}{7000}$ = .017143	.22157	.3492	.9	.388		0	2600.
							0	2640	1032 6
							0	5280	667 0
							1.0108	7920	452 5
							1.0181	9042	386 0
4	Navy experimental bullet, cal. ″.23.	$\frac{135}{7000}$ = .019286	.235	.3492	.9	.388		0	2500.
							0	2640	1009 7
							0	5280	656 3
							1.0108	7920	445 1
							1.0181	9042	379 8
5	Army experimental bullet, cal. ″.22, cupro-nickeled steel jacket.	$\frac{113}{7000}$ = .016	.22	.33058	.9	.36731		0	2700.0
							0	2640	1022 5
							0	5280	647 6
							1.0108	7920	429 8
							1.0181	9042	363 4
6	Navy experimental bullet, cal. ″.23.	$\frac{113}{7000}$ = .016	.23	.30250	.9	.33606		0	2700.
							0	2640	971 3
							0	5280	598 6
							1.1045	7920	384 3
							1.0218	9042	320 1
7	Army cal. ″.30, bullet—if made of steel instead of lead with jacket.	$\frac{140}{7000}$ = .022857	.30	.2539	.9	.28211		0	2300.
							0	2640	815 0
							1.0036	5280	471 0
							1.0181	7554.7	300 0
†	Army bullet, cal. ″.45 as above.	$\frac{500}{7000}$	.45227	.3492	.9	.388	1.0329	9042	286.5
††	Army service bullet cal. ″.45.	$\frac{500}{7000}$	.45227	.3492	1.	.3492	1.0329	9042	246.4

† †† Formulas for high angle fire employed. and (††) coefficient of reduction changed from .9 to 1. for comparison with results in fifth line, horizontal column 1, of this table.

TABLE I, *Continued.*—Computed elements of trajectories, etc., for Army and Navy service and experimental bullets. (Ingalls' Tables and Formulas.)

	DESCRIPTION OF BULLET.	Angle of departure.	Angle of fall.	Time of flight, seconds.	Maximum ordinate, feet.	Abscissa for maximum ordinate, feet.	Maximum danger zone for infantry, in descending branch of trajectory, feet.	Energy, foot-pounds.	Energy per inch of circumference, foot-pounds.
								2054.0	1445.6
1	Army bullet, cal. ".45,	2°16′	3°13′	2.77	31.68	1431.9	108.10	643 12	452 63
		6 42	11 39	7 07	210 26	2994 8	*27 89	289 75	203 93
		15 08	30 25	14 79	788 35	4718 3	*9 79	135 11	95 09
		20 56	42 07	17 73	1335 30	5474 0	*6 36	99 95	70 34
								1954.5	2078.5
2	Army service bullet, cal. ".30, cupro-nickeled steel jacket.	1°15′	2°05′	2.13	18.79	1495.1	172.04	397 37	420 65
		4 19	8 19	5 77	145 00	3041 0	*39 34	175 61	186 33
		10 08	22 18	11 25	550 94	4731 8	*14 02	81 17	86 13
		14 02	31 45	14 41	907 68	5496 5	*9 31	59 14	62 75
								1801.7	2588.4
3	Army experimental bullet, cal. ".22, cupro-nickeled steel jacket.	0°46′	1°25′	1.70	12.06	1524.0	275.25	284 19	408 27
		3 05	6 36	4 95	110 65	3112 7	*49 69	118 58	170 35
		7 39	18 02	9 82	433 29	4767 8	*17 66	54 57	78 40
		10 40	25 58	12 57	709 69	5523 1	*11 81	39 71	57 05
								1874.0	2538.04
4	Navy experimental, bullet, cal. ".23.	0°49′	1°30′	1.77	12.82	1521.5	275.03	305 69	414 06
		3 15	6 47	5 07	115 47	3099 3	*48 34	129 15	174 94
		8 00	18 39	10 03	450 25	4762 8	*17 04	59 40	80 46
		11 07	26 47	12 83	736 14	5518 9	*11 39	42 66	58 59
								1813.4	2623.8
5	Army experimental bullet, cal. ".22, cupro-nickeled steel jacket.	0°42′	1°27′	1.69	10.77	1484.5	399.19	260 08	376 29
		3 06	6 48	5 01	112 90	3127 3	*48 22	104 33	150 60
		7 58	19 24	10 08	458 67	4802 2	*16 33	45 95	66 49
		11 15	28 08	13 00	762 40	5567 8	*10 75	32 85	47 53
								1813.4	2509.7
6	Navy experimental bullet, cal. ".23.	0°46′	1°37′	1.77	12.21	1511.5	335.12	234 68	324 79
		3 28	7 44	5 30	127 36	3133 8	*42 34	89 14	123 36
		9 09	22 54	10 90	536 27	4151 2	*13 61	36 74	50 84
		13 12	33 38	14 26	917 12	5635 1	*8 64	25 49	35 28
								1879.9	1994.6
7	Army cal. ".30, bullet—if made of steel, instead of lead with jacket.	1°16′	2°24′	2.20	21.05	1531.4	147.85	236 04	250 45
		5 13	11 42	6 53	189 41	3139 7	*27 77	78 83	83 65
		12 49	32 18	12 82	729 87	4698 3	*9 09	31 98	33 94
†	Army bullet, cal. ".45 as above.	20°29′	41°46′	17.56	1359.0	5491.3	*6.44	91.15	64.15
††	Army service bullet cal. ".45.	23°36′	48°33′	19.28	1592.0	5584.5	*5.08	67.40	47.45

* Danger zone = $\frac{5'.75}{\text{co-tan. angle of fall.}}$

TABLE II. SMOKELESS POWDERS.

No.	Designations.	Ingredients and Properties.
1.	Ballistite ..... { Nobel powder. Italy. }	50 per cent. nitroglycerine, 50 per cent. dinitro-cellulose with small proportion camphor or benzole, though not necessarily so, cubical grains for small-arms, and in strips of square cross section for large guns. Adopted by English, sold to Italy at royalty of 11cts. per pound (160,000,000 small-arm cartridges). Known in Germany as C/89. Reported that with 8″.27, 238 pounds projectile, velocity 2329 f. s., pressure 14.6 tons. Minister of War in Italy reports that after extensive experiments it has proved entirely satisfactory, this, notwithstanding its high pressures and great heat, causing erosion of the bore of the rifles. Testing magazine arms for rapidity with this powder the barrel became so heated that in some cases the lead of the bullets was fused in their envelopes. Exploded at Avigliano factory, May 16, 1890. Many killed. No details published.
2.	Poudre B..... { Vielle powder. France. }	Secret compound; yellow brown tablets, ″.07 to ″.1 square; thickness of stout note paper. Sir F. Abel thinks it contains picric acid.
3.	French B N..... [France.]	Modification of Vielle powder, strips ¼ inch thick, of length required for the gun charge. Said to stand all service tests satisfactorily, and gives good ballistic results. Almost smokeless but its flash distinct at 5000 yards.
4.	Chilworth Special..... [England.]	Used until lately in Armstrong rapid fire guns. Ammonium nitrate 38 per cent., potassium nitrate 42 per cent., carbon prepared as in Brown powder (underburnt) 20 per cent., as the ammonium nitrate absorbs moisture it is hermetically sealed.
5.	Cordite ..... [England.]	Much like ballistite in appearance, chocolate brown color, and when broken shows light gray section like pumice stone. Supposed to be nitroglycerine, to which is added tri-nitro-cellulose dissolved in a solvent such as acetone or acetic ether, together with some substance for moderating explosive action, such as lamp-black, graphite, solid hydro-carbons. Consistency of moderately thick jelly. Soft and pliable, substance forced through holes, and resulting strings become tough as solvent evaporates. Rate of burning depends on thickness of cord. Said to produce deteriorating effects on the bores of rifles, also is found to exude nitroglycerine when stored in bulk, and becomes dangerous when kept at a temperature of 100° F. When exposed to low temperature, the nitroglycerine liquefies, and, when frozen, the compound becomes inert. Climatic changes do not cause deterioration and hence for this reason large quantities of this powder have been manufactured at Waltham Abbey.

TABLE II. SMOKELESS POWDERS—(*Continued*).

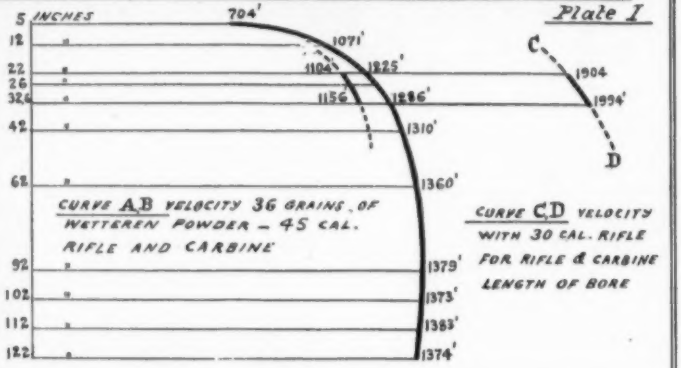
No.	Designation.	Ingredients and Properties.
5.	Cordite (*Continued*), ... [England.]	Maxim's Cordite, 50 per cent. nitro-glycerine, 50 per cent. gun-cotton, or else 2 per cent. nitro-glycerine replaced by 2 per cent. castor oil, in small grains it is easier to manage than in cords, but gives less velocity for same charge. Maxim's Cubes ″.12 gauge, Nobel's Cubes ″.05 cubes, and this latter requires black powder for priming, this addition materially alters the nature of the combustion.
6.	Wetteren,..... [Belgium.]	Secret compound, uneven grain, little lustre (pineapple odor when fired). When sieved, and the bulk of the charge between ″.06 and ″.08 size particles are employed (about 80 per cent. of the ordinary Wetteren powder), pressures and velocities are comparatively uniform as smokeless powders go. This powder has been used by the U. S. Magazine Gun Board (1892) in conducting tests with fifty three rifles and has given satisfactory results. 37 grain charges, imparting an initial velocity of 2000 f. s., to the ″.30 calibre 230 grain bullet, do not develope pressures exceeding 42,000 pounds per square inch. Analysis now being made of this secret compound at the Frankford Arsenal, Pa., will probably determine its constituents. It seems likely that this powder may be used in cartridges for the first issue of the new U. S. magazine rifle.
7.	Dupont's Smokeless.....	Like Wetteren, but hard, smooth and bright —(secret compound).
8.	Walsrode.....	About equal to Wetteren, if not superior—(secret compound).
9.	Maxim Cordite..... ..	50 per cent. nitroglycerine, 50 per cent. gun-cotton with one or two per cent. of castor oil, in cubes ″.12 gauge, has been shown to be a very satisfactory smokeless powder as far as the tests have indicated.
10.	Graynite or Graknit..... [Russia.]	Nitrocellulose base has given satisfactory results in Russia. A modified form of Graknit or Gray powder called "Apyrite" has been used in Sweden. It gives good velocities with low pressures 14.7 tons. Absorbs moisture readily, but does not deteriorate in giving it off. Much less heating effect than that due to black powder, but fouling properties have only of late been modified or reduced.
11.	Noble C/89..... [Germany.]	Has not given altogether the best results in small arms. High pressures and excessive heating results, about 6° per round. It is almost smokeless, is coated with graphite to prevent caking, exuding and absorbing moisture. This coating induces hang fires and demands the use of strong primers in the cartridge.

TABLE II. SMOKELESS POWDERS.—(*Continued*).

No.	Designation.	Ingredients and Properties.
11.	Noble C/89. (*Continued*) [Germany.]	Heat increases its ballistic qualtities. Late improvements in this powder have led to large appropriations for its manufacture.
12.	Smokeless Powder,..... [Denmark.]	Secret compound; gives good velocity: moderate pressure and but little fouling.
13.	Smokelesss Powder..... [Russia.]	Secret compound. Three powder factories working full force and a fourth factory lately erected. An order for 12,857 tons of smokeless powder placed at the Schüsselburg works near St. Petersburg.
14.	Smokeless Powder..... [Spain.]	Secret compound. Manufactured at Bilboa and Grenada.
15.	Smokeless Powder ..... P.C/89. [Switzerland.]	Secret compound. Manufactured in the form of square wafers of light brown color.
16.	Smokeless Powder..... [U. S. Navy.]	Secret compound. Has stood severe heat, water, and detonating tests, and is expected to show good staying qualities. With the ″.30 calibre 215 grain bullet, a velocity of 2100 f. s. results, and with pressure not exceeding 12 tons per square inch. The 6″ gun, with 100 pound projectile, gives with this powder 2300 f. s. and pressure of 14.4 tons per square inch.
17.	Smokeless Powder ..... [U. S. Army.]	The Troisdorf, Wetteren, Rifleite and others are undergoing tests and analysis at the hands of the ordnance authorities.
18.	Rotweil 12″.....	Collodion cotton 45 per cent., Gun-cotton 13 per cent., Nitroglycerine 31 per cent., moisture, resins, salts, residue, etc., 11 per cent.
19.	Troisdorf 1″.....	Collodion cotton 69 per cent., Gun-cotton 24 per cent., no Nitroglycerine. Moisture, resins, salts, residue, etc., 7 per cent.
20.	New Wetteren.....	Collodion cotton 7 per cent., Gun-cotton 83 per cent., no Nitroglycerine. Moisture, resins, salts, residue, etc., 10 per cent.
21.	Laflin & Rand W.A. S.P.	Secret compounds furnished U. S. under contract. For service Small Arm Ammunition Cal. ″.30.
22.	Peyton S. P.....	
23.	DuPont S. P.....	

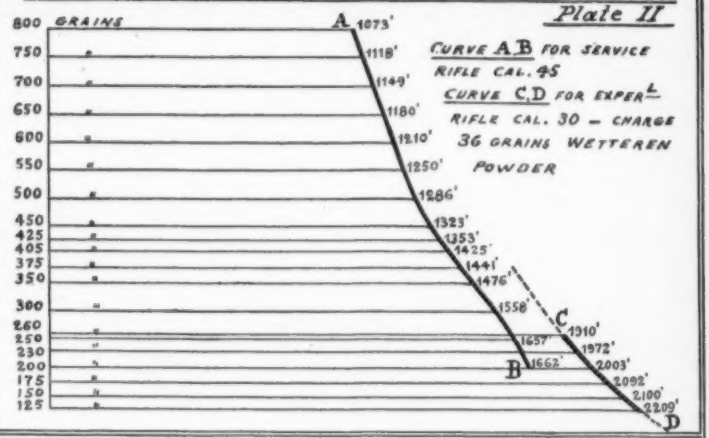
INITIAL VELOCITIES DUE TO VARIATION IN LENGTH OF BARREL

Plate I



INITIAL VELOCITIES DUE TO VARIATION IN WEIGHT OF BULLET

Plate II



INITIAL VELOCITIES DUE TO VARIATION IN POWDER CHARGE

Plate III

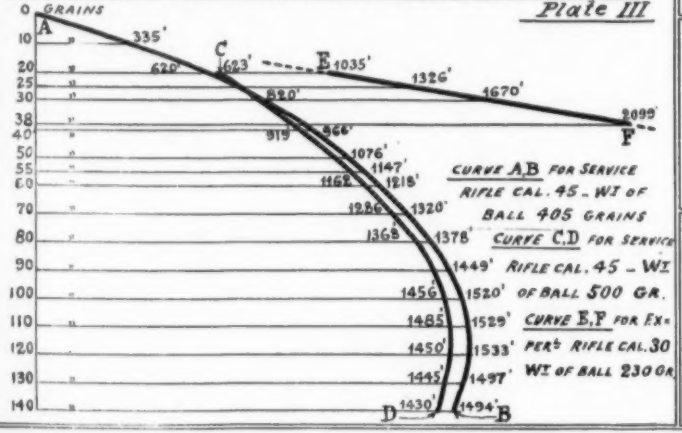


Plate IV

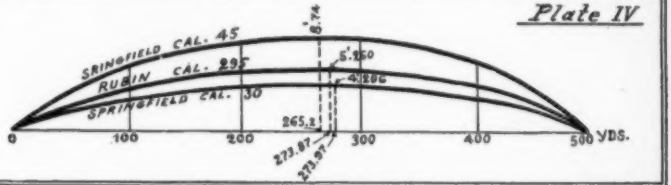
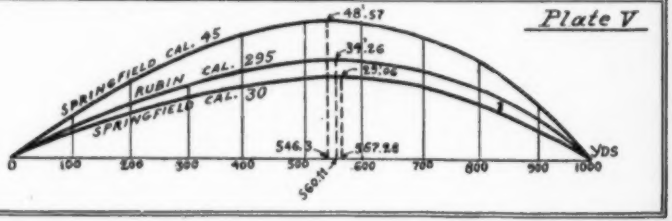


Plate V



VELOCITY AND PRESSURE CURVES

VELOCITY CURVES EXPERIMENTALLY DETERMINED FOR VARIOUS BARREL LENGTHS — PRESSURE CURVES FROM $P = m\frac{dv}{dt} = mv\frac{dv}{dx}$

CAL. 30 RIFLE

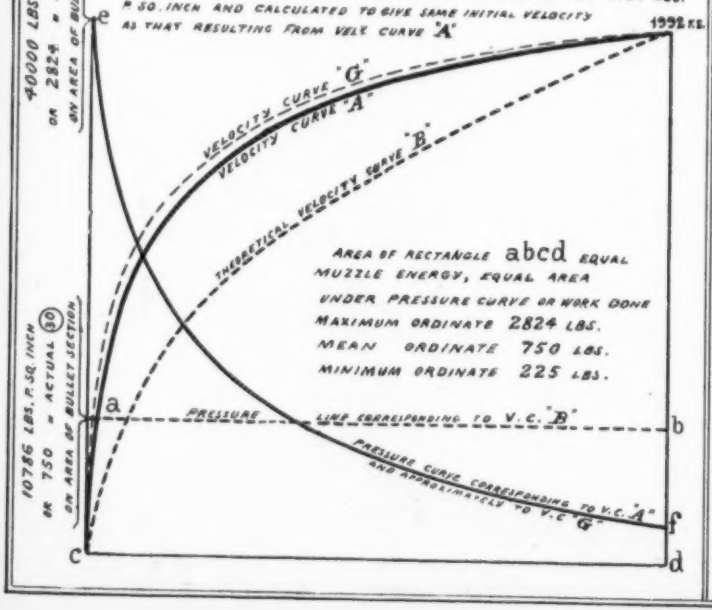
Plate VI

MUZZLE ENERGY 1940 FT. LBS

VELOCITY CURVE "G" FOR A CLAIMED SO CALLED NON-RECOIL SMOKELESS POWDER - 220 GRAINS BULLET

VELOCITY CURVE "A" FOR WETTEREN POWDER - 220 GRAINS BULLET

THEORETICAL VELOCITY CURVE "B" FOR AN ASSUMED POWDER GIVING A UNIFORM PRESSURE THROUGHOUT THE BARREL OF 750 LBS. OR 10786 LBS. P. SQ. INCH AND CALCULATED TO GIVE SAME INITIAL VELOCITY AS THAT RESULTING FROM VELY CURVE "A"


40000 LBS. P. SQ. INCH OR 2824 = ACTUAL (30) ON AREA OF BULLET SECTION
10786 LBS. P. SQ. INCH OR 750 = ACTUAL (30) ON AREA OF BULLET SECTION
e
1992 F.S.
VELOCITY CURVE "G"
VELOCITY CURVE "A"
THEORETICAL VELOCITY CURVE "B"
AREA OF RECTANGLE abcd EQUAL MUZZLE ENERGY, EQUAL AREA UNDER PRESSURE CURVE OR WORK DONE
MAXIMUM ORDINATE 2824 LBS.
MEAN ORDINATE 750 LBS.
MINIMUM ORDINATE 225 LBS.
a
PRESSURE LINE CORRESPONDING TO V.C. "B"
b
PRESSURE CURVE CORRESPONDING AND APPROXIMATELY TO V.C. "A" AND "G"
c
f
d

CAL. 45 RIFLE

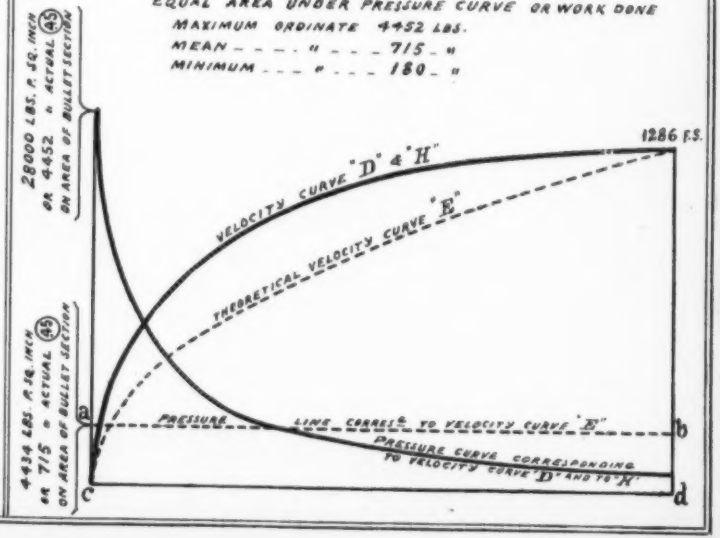
Plate VII

MUZZLE ENERGY 1838 FT. LBS.

VELOCITY CURVE "D" FOR BLACK POWDER - 500 GRAINS BULLET ALSO NEARLY CORRESPONDING TO VELOCITY CURVE "H" FOR A CLAIMED SO CALLED NON-RECOIL POWDER

THEORETICAL VELOCITY CURVE "E" FOR AN ASSUMED POWDER GIVING A UNIFORM PRESSURE THROUGHOUT THE BARREL OF 715 LBS. OR 4434 LBS. P. SQ. INCH

AREA OF RECTANGLE abcd EQUAL MUZZLE ENERGY
EQUAL AREA UNDER PRESSURE CURVE OR WORK DONE
MAXIMUM ORDINATE 4452 LBS.
MEAN - - - - " - - - 715 - "
MINIMUM - - - " - - - 180 - "


28000 LBS. P. SQ. INCH OR 4452 = ACTUAL (45) ON AREA OF BULLET SECTION
4434 LBS. P. SQ. INCH OR 715 = ACTUAL (45) ON AREA OF BULLET SECTION
1286 F.S.
VELOCITY CURVE "D" & "H"
THEORETICAL VELOCITY CURVE "E"
a
PRESSURE LINE CORRES. TO VELOCITY CURVE "E"
b
PRESSURE CURVE CORRESPONDING TO VELOCITY CURVE "D" AND TO "H"
c
d

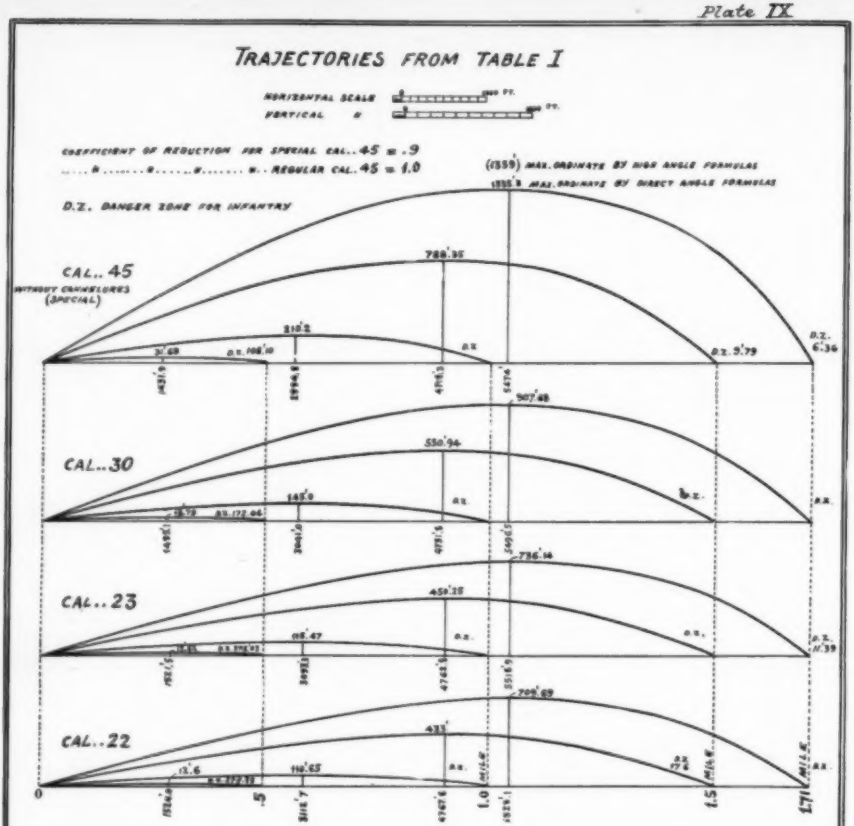


FIG. 6

CAL..45 CARTRIDGE
WITH FLAT ANVIL PRIMER

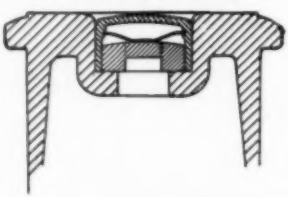


FIG. 7

CAL..30 CARTRIDGE
WITH ARCHED ANVIL PRIMER

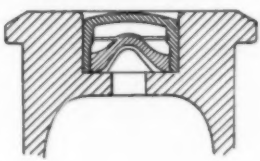


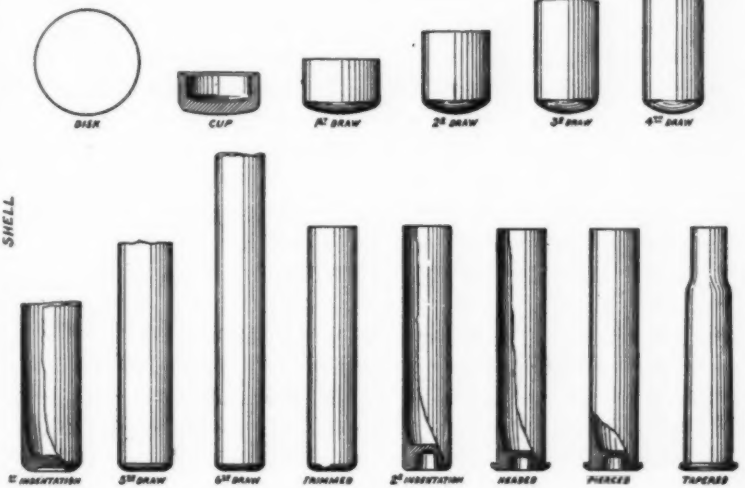
FIG. 8

1895 MODEL - CALIBER .30 CARTRIDGE

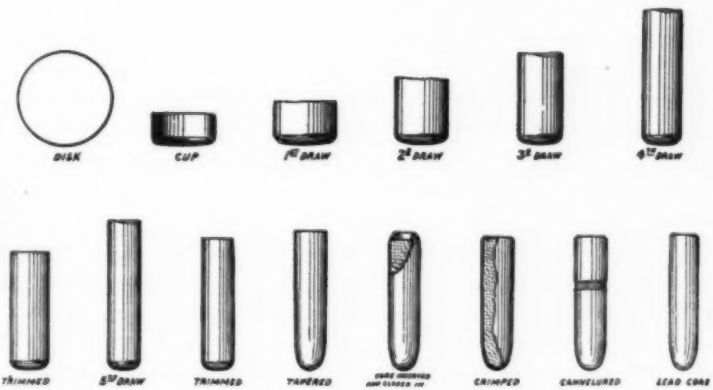
The Danger Zones not entered on the above plate, will be found on Table I.

FRANKFORD ARSENAL - 1895 - .30 CAL. CARTRIDGE

SHELL



BULLET



THE ENGINEER BATTALION OF THE FIFTH ARMY CORPS.

By Captain THOMAS H. REES, Corps of Engineers, U. S. Army.

THE Engineer troops attached to the Fifth Army Corps in its expedition to Santiago de Cuba were Companies C and E of the Regular Engineer Battalion.

E Company, from West Point, N. Y., under command of Captain Lusk, with First Lieutenant Winslow and Second Lieutenant Ferguson, proceeded to New York the last of April, 1898, and embarked on the *Alamo* for Key West, Fla., taking with them the engineer material that was provided for the campaign. A list of this material would fill several columns of this paper, but to generalize, it comprised bridge material of both the reserve and advance guard equipage, that is, wooden and canvas pontons and trestles with the necessary balk, chess, lashings, anchors and cables, oars and other supplies; large stores, picks, shovels and axes, sappers' and miners' tools, carpenters' tools, rope, blocks and falls, bars, sledges, wire nippers, reconnoissance outfits, etc. One entire deck of the transport was filled with this material, and there was afterwards added at Tampa additional supplies of rope, bridge and wharf timber, folding-boats, scythes and brush hooks. On other transports there were shipped 250,000 sandbags.

After several days at Key West, E Company was directed to proceed on the *Alamo* to Tampa, to join the expeditionary force that was being organized at that point. The only incident of the voyage was a strike and mutiny of the firemen of the ship at Key West, soon quelled, however, by a show of military force. Arriving at Port Tampa, E Company went into camp, and while awaiting further movements, overhauled and shifted the entire cargo of the *Alamo*, stowing it in such manner that every part of it would be readily accessible and might be quickly unloaded.

C Company, at Willet's Point, received orders on May 13 to proceed by rail to Tampa, and started at 6 o'clock the next morning, under command of Captain Fitch, and with First

Lieutenant Rees and Second Lieutenants Hoffman and Cheney. Arriving at Tampa about 10 P. M. on the 15th, it was ordered to join E Company at Port Tampa, and went into camp there on the following morning. At the same time Lieutenant Lytle Brown was ordered to Tampa to join E Company.

A few days later the two companies were organized into the Battalion of Engineers of the Fifth Army Corps, with Captain Lusk in command. During the three weeks that intervened before embarkation the battalion was engaged daily in practicing the construction of shelter and siege trenches and gun-pits, and in infantry and pontoneering drills.

Captain Lusk being appointed lieutenant-colonel of volunteers and chief engineer of the Second Corps, he was succeeded in the command of the battalion by Captain Burr, who afterward became lieutenant-colonel of the 2d Volunteer Engineer Regiment, but remained with the battalion until August 1.

The Engineers embarked on the *Alamo* June 6, and were afterwards joined by a battalion of the 10th Infantry and two troops of the 10th Cavalry; also by headquarters of the Second Brigade, First Division, and of the 10th Regiment Infantry.

A week was spent in constant expectation of sailing, enlivened at one time by a midnight alarm of a Spanish fleet, routing out of boats' crews, opening of ship's ports, launching of pontons, and pulling away into the darkness with messages and orders from ship to ship. The next day found the entire fleet packed like sardines in the Port Tampa slip, instead of sailing proudly away for Cuba. At last, on June 14, the fleet sailed. There were but 700 troops on the *Alamo*, but so much space was occupied by engineer property that the men were crowded and uncomfortable. All realized, however, that this was unavoidable and bore their discomfort cheerfully, being only too glad to be numbered among the members of the first expedition of the war. The voyage was uneventful and monotonous.

On the 20th of June the fleet arrived off Morro Castle at the mouth of Santiago Harbor, and lay wallowing in the trough of the sea all day. So also on the 21st, but late at night, from the darkness alongside, came the sweet notes of the megaphone,

"Rendezvous at daybreak, ten miles east of Morro, five miles from shore." On the morning of June 22d, after a naval bombardment that drove out the Spaniards, the debarkation began at Daiquiri. The iron-ore pier at this point was useless for landing troops, owing to its great height, and to the fact that ships could not lie alongside in the heavy swell that was running. There was, however, a good cribwork pier with a depth of water at the outer end of 8 or 9 feet. The pier head was about 35 feet square, and the western half of it was decked over. A railroad track led out along the middle line of the pier. The trestle carrying the track from the cribwork to the shore had been partially destroyed by fire, which was still smouldering while the troops were landing.

About noon on the 22d, details from the Engineers launched three pontons from the ports of the *Alamo*, loaded them nearly to the gunwales with bridge material and tools, and started for shore. The difficulty of this work will be appreciated when it is remembered that the ship was rolling heavily, and that the ports were sometimes almost awash, and sometimes 6 or 8 feet above the water. To stick a 30-foot ponton out through the side of a ship and get her clear without smashing things, was under these conditions no ordinary undertaking. No opportunity could be found for unloading the tools and other material until night. Ship's boats and navy launches packed full of troops swarmed three or four deep around the pier all day, and to bring the heavily laden and unwieldy pontons among them would have endangered the boats and delayed the landing of troops. So the pontons hung to a mooring buoy awaiting a chance to get in. About nightfall there was a cessation in the stream of boats and the pontons were warped in to the pier and unloaded. A detail proceeded at once by the light of lanterns to floor and repair the trestle leading to the pier head. Intrenching tools and axes, hatchets, etc., were carried ashore and stored in a house seized for the pupose, whence they were subsequently issued to the troops. About midnight the working parties knocked off and went to bed supperless on the ground. Next day the work of the Engineers thus fairly begun was interrupted and they were ordered off on the *Alamo* to Aserradero, about 20 miles west of Santiago, to assist in the embarkation of General

Garcia's Cuban army. Lieutenants Hoffman and Cheney were detached and assigned to duty under Lieut.-Colonel Derby's orders for reconnoissance and map work. Each had with him a small detail of Engineer soldiers. Lieutenant Ferguson was left at Daiquiri, with a guard of about six men, in charge of the tool depot. He rejoined at Siboney a week later.

Aserradero is a little nook or cove in the coast protected by a coral barrier reef through which a deep narrow passage gives access to the still water inside. Here the Engineers constructed a boat landing by extending an old pier about 125 feet. Posts of 5 in. by 5 in. scantling were driven in pairs, with heavy mauls, in the sandy bottom. These were capped and floored with plank, thus providing a landing at which three or four loaded ship's boats could lie on each side. On June 25th, General Garcia's force of 3000 men was safely and quickly embarked on three transports, by the use of the ship's boats and two navy steam launches that towed the boats.

The *Alamo* returned to Siboney the following morning and before dark a detachment of Engineers had completed a small pier to serve as a boat landing. It consisted of a crib 7 feet square sunk in a depth of about 6 feet of water and loaded with scrap iron. An intermediate trestle carried the joists and flooring that bridged the space of 50 feet between the crib and the shore. This served merely as a temporary makeshift, and as Siboney had become the base of operations of the army the Engineers were ordered to construct a wharf that could be used by steam lighters and tug boats in landing troops and supplies. Two days were spent in unloading the tools, part of the bridge equipage, the heavy timber and other engineer stores and in establishing an engineer depot. This was heavy work, as the pontons had to be launched through the ports of the ship in a seaway, loaded with heavy material, rowed one or two miles to shore, and unloaded on the beach in a heavy surf. The heavy timber had to be launched overboard, rafted together and towed ashore with the pontons. The battalion went into camp at Siboney and on the 29th began work on the large pier. This was to consist of a crib 30 feet square, divided by two timber bulkheads each way into nine pockets, of which the middle ones on each of the four sides were to be floored to carry the sink-

ing load, the other pockets being left open at the bottom to hold an anchoring load of stone and scrap iron. By this arrangement, any undermining of the crib by wave action would be filled by the escape of the stone from the open pockets, and the crib itself would not be affected. The crib was to be sunk in a depth of 10 feet of water, which depth was found at a distance of 130 feet from shore. Smaller cribs sunk on the axis of the pier were to carry the joists, flooring and railroad track to the pier head. Fortunately an ample supply of 12-inch, 16-inch, and 18-inch pine timber was found at Siboney, and this was used in the construction of the pier, as well as that brought on the *Alamo*. The timbers were notched into each other at the corners and crossing points, so as to leave 6-inch intervals between the timbers. While the 30-foot timbers were being cut and framed for the big crib, the smaller cribs were constructed and sunk and by July 1st two of these were in place and a third was begun. On the afternoon of the date last mentioned orders were received directing the battalion to proceed at once to the front, and the alacrity with which the Engineers threw down the tools and shouldered their muskets and blanket rolls showed that they hoped to join in the next day's fighting. In this, however, they were disappointed and found only more hard work awaiting them. Arriving near General Shafter's headquarters about midnight, after a long day's work and a long night march in the mud, they threw themselves on the ground for a few hours' sleep and at daybreak were on the march again, carrying picks, shovels and axes in addition to guns, rolls, haversacks, canteens and cartridge belts.

A four-mile march brought the battalion to the crossings of the Aguadores and San Juan creeks near their junction. This was on the 2d of July, when our troops occupied the top of San Juan ridge just beyond the creek, and lying in the trenches maintained an almost continuous fire on the lines of the Spaniards, which the latter as constantly returned. The creek crossings were at just the proper distance to receive the Mauser bullets that grazed the crest of the ridge and dropped in the valley, and at times the patter of the bullets on the water and through the leaves was like the beginning of a shower of rain. Here, all day long, the Engineers worked on the ford and

the roads in that vicinity, cutting down the bank to an easy slope, filling up mud holes with poles and brush and making the ford practicable for wagons and pack trains. To protect the working parties against guerrillas a guard was sent out to beat the brush and search the trees for sharp-shooters. Men of various organizations were constantly passing to and fro between the firing line and the rear. At times when a succession of volleys would bring a flight of bullets over the hill, they would crouch under the bank and wait for a cessation of the firing before passing on. Numbers were hit and several killed at the crossings, but through it all the Engineers worked doggedly on, without the excitement of fighting, without a chance to fire back or even to see the enemy. About 4 o'clock the work at this point was completed as well as was possible with the material available, and in accordance with their orders the battalion marched back to headquarters. This closed the day's work, except for a night alarm and a hurried turning out under arms with orders to hasten to the front when the Spaniards made their sortie about 10 o'clock. These orders were soon revoked, however, and the battalion returned to camp.

The next two days were spent in working on the roads near Savilla and then the Engineers were ordered back to Siboney to finish as soon as possible the pier already begun. And indeed the necessity for this work was urgent, for at this time all the supplies for the army were being landed by one large ship's boat, which was warped back and forth between the shore and the steam lighter that brought the supplies from the ships, and anchored as close in as possible. Men waded through the surf to the boat and carried the supplies ashore. It is doubtful if ever an army of 18,000 men was supplied under greater difficulties.

While the battalion of Engineers was absent from Siboney, the work on the pier was continued by Company A, 33d Mich. Volunteers, which company had been assisting in the work from the start. They had partially completed the third crib, 30 feet long by 10 feet wide, and it was soon in place with a track laid to its outer end, and the pier could now be used as a boat landing. Meanwhile ways had been constructed on the sloping beach, and the timbers being already cut and framed, the 30-

foot crib was begun on the ways just above the surf line. Three courses of four timbers each were laid and drift bolted together, and the partial crib thus formed was launched through the surf and floated alongside the pier. Additional timbers were brought out on cars and rolled off onto the crib which was rapidly built up until it nearly grounded. Then four anchors were dropped off the shore with their cables leading properly to the position of the pier-head, and these with the assistance of the shore lines were used to warp the crib into its place, where it was again built up until it grounded, partially loaded with scrap iron and stone, and finally completed to its full height. The full load was not added until the track was laid, so that ore cars could be run out to the crib and dumped into the pockets.

The pier was completed by July 12th in not more than nine actual working days. The work was accomplished on an open beach subject to the full sweep of the Caribbean Sea. The surf was always heavy and would sometimes pick up the timbers and hurl them away as they were brought into position, endangering the lives and limbs of the men. Often it was necessary to haul the timbers into place with ropes and lash them until they could be bored and bolted. Men were frequently washed overboard, but would swim back and resume their work with scarcely a comment, so common was the occurrence. Another hindrance to the work was the constant use of the pier from the time it was half completed. Troops were landing with their tentage, rations and ammunition. Commissary and hospital supplies were constantly coming ashore. Then the wounded and sick began to come in from the front to be sent aboard the transports and strings of litters would occupy the pier. The details provided for handling the baggage and supplies unloaded on the pier were always inadequate, and the Engineers had to be taken from their work to carry such material ashore and clear the pier in order that the work could go on. When the pier was completed the steam lighters could come alongside and discharge their cargoes directly into the cars which hauled the supplies to the storehouses and hospitals.

While this work was going on other detachments were engaged in the care of the depot and issuing of tools in repairing

the pipe line of the water system, in working on the roads and in operating the railroad. Two engines that had been damaged by the Spaniards by the removal of certain parts were repaired and used to great advantage in hauling supplies and in transferring the sick and wounded from hospitals to the pier for embarkation. On July 1st, Gen. Duffield's Brigade of Michigan troops was taken to Aguadores on trains manned by Engineer soldiers. One of the engines was repaired, and at first operated by Lieut. Frissell, 3d Infantry, and in this connection the writer desires also to mention the good work done by Lieut. C. B. Humphrey, 3d Infantry, in repairing the railroad bridge at Siboney.

After completing the pier the Engineer Battalion was engaged until the surrender of Santiago in working on the roads, which were in a frightful condition. Many wagons were stalled in the mud carrying only a third of a full load and long stretches of the road were in the condition of a deep, sticky slough. Wherever it was possible, new roads were opened up by cutting through the brush parallel to the old road. In other cases the road would be drained and opened up to the sun and wind by cutting overhanging trees and brush. There was no suitable material for corduroying the roads, and where other means were unavailable a covering of brush was laid with the butts even along the edges of the road and the tops crossing and interlocking and all trimmed close, and packed down by stamping and treading. This formed, indeed, but a poor road, but it at least carried the wagons over mud holes and sloughs that had been impassable. In all, about five miles of the road were improved or opened up by the battalion. The remainder of the road was worked by details of infantry and cavalry troops under the direction of Lieut. Lytle Brown, who was detached from the battalion and assigned to this work on July 3d.

On July 15th, the day after the surrender, Lieut. Colonel Burr was directed to go to Aguadores and confer with the Spanish commander in regard to repairing the railroad bridge at that point, a portion of which had been destroyed by the Spaniards. The Spanish commander at Aguadores, not having learned the terms of the surrender, refused to permit an examination of the bridge, and it was not till the next day that the examination

could be made and plans for the repairs decided upon. On the 17th a picked detachment of Engineers, together with a detachment of the 33d Michigan Volunteers proceeded by rail to Aguadores with the necessary timber and tools, and began work on the bridge. The portion destroyed consisted of two spans of girders, each about 30 feet long, that had been dropped to the ground by the destruction, with dynamite, of the iron pier that supported their ends. The track, ties, and braces formed a tangle of débris covering the fallen girders. The first day's work was the removal of this wreckage, and the laying out and cutting of the trestle timbers. A day and a half more sufficed for framing and raising the trestles, three in number, laying four lines of stringers of 12-inch timber, completing about 100 feet of track on the bridge, and repairing the track at other places beyond Aguadores where it had been torn up. On the afternoon of July 19th the first train ran through to La Cruz, the terminus of the railroad, about a mile from Santiago. On the 20th a washout, caused by the waves, in the embankment that carries the railroad along the foot of the cliffs, was repaired. A wall of stones weighing half a ton or more was built up to resist the sea, and the embankment was filled in behind this wall with smaller stone. The large stone was handled by a derrick car.

Orders had been received directing the battalion to proceed as soon as the railroad was open to La Cruz. When the buildings at Siboney were burned the engineer tools and stores were taken from the storehouse and loaded on cars where they had remained in anticipation of this move. On July 22d the battalion broke camp at Siboney and embarked on the train with ten carloads of stores and equipment, for La Cruz, and there went into camp under orders to be in readiness to move, when notified, to Cuabitas, four miles north of Santiago, and repair the railroad bridges over Purgatoria Creek at that point and over Virgin Creek at Boniata, two miles beyond Cuabitas. While awaiting such notification, the engineer property was stored on the coal wharf at La Cruz, ready for shipment, and some work was done on the roads between La Cruz and Santiago. Arriving at Cuabitas on the 27th the battalion went into camp and at once began work on the Boniata bridge. The two bridges

mentioned were built about forty years ago and are curiosities in trestle construction. The material is native timber, very hard and durable, and of a rich dark red color. The joints were all deeply mortised and fastened with wooden pins, except in the stringers, which had long hooked scarf joints, bolted through. The construction was in the form of trestle bents at intervals of about 25 feet, with corbels, inclined braces and straining beams to support such long spans of stringers.

These bridges had been burned by General Garcia's forces to prevent the escape, by rail, of the Spanish troops. The Boniata bridge was about 35 feet high and 250 feet long. A length of 80 feet was destroyed, and had to be rebuilt. The Purgatoria bridge was about 600 feet long and 30 feet high, and a length of 300 feet had to be rebuilt. The Boniata bridge was completed July 31, and thereafter trains ran from San Luis and Songa to Cuabitas, connecting with trains between Cuabitas and Santiago. In the work on the Purgatoria bridge frequent delays were experienced, due to the slow arrival of the timber, which was brought by rail from Siboney to La Cruz, then hauled to Santiago and sent out on cars to Cuabitas. The original method of construction was not followed in the repairs. Simple trestle bents, with diagonal bracing, were erected at intervals of about twelve and one-half feet and these carried the stringers, ties and rails. Seventeen trestles were required in the Purgatoria bridge, besides some repairs of the unburned portion of the bridge. A small force of Cuban carpenters and laborers, employed by the railroad company, assisted in the work. On August 16 this work was completed, and in the evening of that day the first train ran through from Santiago to San Luis.

On August 1, Lieut.-Colonel Burr was relieved of the command of the battalion and sailed for home under orders to join his regiment, the 2d Volunteer Engineers; and on the same day, Major Fitch, who had been promoted to that rank, was assigned to General Lawton's division as chief engineer, leaving Lieutenant Rees in command of the battalion, Lieutenant Winslow in command of E Company, and Lieutenant Ferguson in command of C Company.

The work of the officers and detachments detailed for recon-

noissance and map-making, deserves special mention. From the day of the landing they were constantly on the go, scouring the country in advance of the army and coming in at night with notes and sketches, to report to the chief engineer of the corps, under whose direction the sketches were compiled into maps, blue prints of which were issued to division and brigade commanders. The only fault to be found with this branch of the work, is that instead of six officers, there should have been about sixteen engaged in it, if that number could have been spared for this purpose.

The Engineers had worked on for a month after the formal surrender, while other troops had little to do besides making themselves comfortable in camp. They worked on, while daily they saw other organizations embark for home, leaving them among the last. In the low river bottoms, shut out from the breeze and exposed to the fierce sun, they wielded axes, saws, hammers and bars, while daily, two or three of their number staggered or were carried back to camp, stricken with the fever, until over one-third of them were down. And withal, there was not a more cheerful and contented body of men in Cuba than they. Their work kept them interested, and prevented among them the despondency and gloom that visited many of the camps after the surrender.

In the Civil War in this country the number of Engineer troops necessary to perform the work of that arm was about five per cent. of the total force. In Cuba the Engineers numbered about one per cent. of the army. If they did not accomplish all that was apparently expected of them, it was only because they could not work miracles. They were assigned to the work that was considered most important, and executed that work thoroughly and rapidly. Their service in Cuba was varied, laborious, and valuable, and whether that service is recognized or not, they make neither excuses nor complaints, and are ready to go again whenever and wherever ordered.

Reprints and Translations.

ARTILLERY AT THE BATTLE OF OMDURMAN.

By L. OPPENHEIM (Special Correspondent of the "Central News" With Nile Expeditionary Force).

From United Service Magazine (London).

A BATTLE in which each field battery fires over 500 rounds—one firing nearly 1000 rounds—must always, I think, be memorable in the history of artillery.

I search in vain in the records of British and foreign artillery for another engagement in which anything approaching that number of rounds was fired.

But the part played by the artillery in the battle of Omdurman was conspicuous, not merely on that account, but especially because after the 2d September, 1898, any doubts which may possibly have existed as to the actual effect of modern shrapnel in the open, on living men, must forever be set at rest.

The great plain on which the battle was fought is almost perfectly level and smooth, is uncovered by any vegetation beyond tufts of grass: open and clear, it gave the enemy absolutely no cover; they were completely exposed, from beginning to end, to full "view and fire."

The Sirdar's position was unsurpassable from the point of view of a general who had to fight a defensive battle against such an enemy as the Dervishes, but it remained to be proved that no large body of men could struggle across the zone of the artillery fire to within effective reach of the rifle and Maxim fire. And this, I believe, was clearly proved by what was seen during the first and second engagements.

Amply tested in practice, the fearful effect of shrapnel on living men had never before been so demonstrated. Never before has there been, and, probably, never again will there be, a battle in which dense bodies of men attempt to cross such a terrific fire zone.

Indelibly demonstrated in the blood of these, the bravest men on earth, the destructive power of shrapnel in the open need never more be open to doubt.

It will be remembered that the attack on the zareiba began about 6.40, when the long line of the Dervish host appeared along the summit of the rise which lies southwest of the zareiba, and runs for a distance of some three miles east to the river, and west to the so-called Kerreri range of hills. At this moment they were about 1800 yards from Major Laurie's Egyptian battery, which opened fire. A few seconds after, the 32d Field Battery (Major Williams) and the two Egyptian batteries (under

Captain de Rougemont and Bimbashi C. G. Stewart) opened on the Dervish right, which was slightly thrown forward, and had now reached the base of the rise between the hill El Surgham and the Nile. A few rounds from these three batteries completely withered the Dervish attack at this point. I went over the ground immediately after the first engagement, and the dead were lying in countless heaps. These men had all been killed during the very few minutes in which the three batteries were firing at them. This wing of the Khalifa's army never recovered, and fell back behind the hill El Surgham, although not one single long-range volley or round from the Maxims was opened on them.

The centre of the Dervish army now came on at the centre of the zareiba, wave after wave of white figures with crests of flags and spears. The three batteries on the left, and Laurie's battery at the centre corner, began firing at about 1700 yards' range, continuing up to 800 yards. Close bodies of riflemen, followed by phalanxes of spearmen, were advancing round their flags. Wherever you turned your eyes in a south-westerly direction you saw the same flood of men round countless flags. As the artillery fire continued, these flags dropped, ten or twenty every few seconds, and the implication was sure that with every one flag-bearer there dropped twenty others. As the masses of the enemy got to within 1200 yards' range of the zareiba, the effect of the Maxim and rifle fire must not be ignored, but I cannot think that it was very great at a range much over 900 yards, and nearer to the zareiba than 800 yards no large unbroken body of the enemy ever came.

Isolated groups here and there struggled on, attempting the impossible—proving the heroic bravery of our enemy—but the great wave of men was dammed before it got within 900 yards of the zareiba—and dammed by the terrific shrapnel fire.

Almost simultaneously with the attack on the centre of the zareiba came the attack on its right. This proved even more conclusively the murderous effect of the fire of the artillery. Early in the morning the Khalifa had swung round his left, intending, apparently, either to envelop the zareiba from all sides— or else, by attacking the Sirdar all along his line, and by being repulsed, to beguile him into advancing from his position—while a large reserve force, under Ali Wad Helu and Osman Sheikh Ed-din, lay behind the Kerreri hills awaiting events.

Whatever were the Khalifa's tactics, an attack in force, headed by horsemen, was made on our right or west front. Here the plain was open to a further distance than on the south front, and the batteries under Major Laurie and Captain Peake opened on them at 3000 yards' range, while one gunboat, stationed to protect our right rear, enfiladed them at long range. This attack was repulsed with such terrific loss to the enemy that they retired before the infantry or Maxims had fired a single round at them. The Dervishes never approached within 2000 yards of this side of the zareiba, and retired, leaving about 1300 bodies on the field. These were counted three days after the battle.

It is not so easy to prove the decisive effect of the artillery fire during the second phase of the battle.

The attack on General MacDonald's and General Lewis's brigades was made, it seems, by the flower of the Dervish army. The army corps under Ali Wad Helu (part of which had attacked the right front of the zareiba) seems to have now combined with the reserve division under the Khalifa himself, who was accompanied by Osman Digna (?), Yakub, and Osman Sheikh Ed-din. This phase of the battle began when General MacDonald, deployed for the attack, was facing south, while General Lewis faced west. Laurie's, de Rougemont's, and Peake's batteries came into action in front of MacDonald's line, while Major Young's horse battery opened fire from the hill El Surgham at about 900 yards' range. The field batteries opened at a range of 1200 yards, and it was clear that the destruction which they dealt was fearful. The Dervish attack was, however, pushed home with desperation, and our infantry, coming up into line with the field batteries, opened volleys at about 900 yards' range.

The Dervish assault was led by bodies of horsemen, who, galloping at racing pace, hoped, doubtless, to break the line and force an opening for their infantry.

From the moment when the infantry began to fire, it was impossible to distinguish between the effect of the small-arm fire and that of the artillery, for the smoke of the Martinis of MacDonald's brigade made it hard to see far.

At about 600 yards' range the three field batteries began "case," and this they kept up for some minutes, the range being at one time 400 yards. For a body of some forty horsemen round Yakub's flag, in defiance of the hail of lead, hoping, doubtless, to force an entrance into our lines, actually galloped to within 350 yards of MacDonald's and Lewis's lines before they were annihilated by the cross-fire of the field batteries, and the horse battery, and the infantry and Maxims.

Immediately afterwards an equally fierce attack, headed by Ali Wad Helu's horsemen, was made on MacDonald's right. One battalion was thrown back, forming a wedge-shaped square, the batteries being at each end and at the angle.

At the right extremity the Lincolnshire Regiment came up at the double and joined the firing-line, while the Camel Corps were dismounted, and also joined the firing-line on the right of the Lincolns.

The rest of the engagement was precisely similar to what had come before: attacks were desperately pushed home by bands of horsemen, followed by waves of riflemen and spearmen.

The admirably executed changes of front by General MacDonald's brigade, of which so much has been said, brought it eventually almost into line with General Lewis's brigade; and, the attack ceasing, the two brigades advanced westward, breaking up the routed Dervishes.

Each of the three field batteries who were engaged with General Mac-

Donald's brigade, had fired some eighty rounds of case; and this speaks for itself of the fierceness of the Dervish assault. Time after time bodies of horsemen had charged towards MacDonald's line, being annihilated at ranges from 1200 to 400 yards; but, although the Dervish infantry followed in dense masses, I do not believe any unbroken body of them ever got within 900 yards of the line, although the same groups of men, round flags, struggled hopelessly on at every point.

The accuracy of the field-guns, the strength and general excellence of their equipment, and the admirable fire-discipline of the Egyptian batteries had been clearly proved before the battle. But emphasis must certainly be given to the praise which the battery commanders had previously earned, for their right to it has been confirmed by the experience of actual warfare.

Of the effect of the fire of the howitzers so much has been said that I shall regard it as not within the province of this article, which deals purely with what I myself saw and noted on the battle-field.

THE FUTURE OF THE CHINESE EMPIRE.

By C. PFOUNDES.

(From the United Service Magazine, London.)

THE future of the Chinese empire is one of the most important problems of the present moment. The peace of Europe and of the extreme Orient depend upon statesmanship that will be successful in avoiding war, in connection with the complications that have developed and which have recently culminated in a very critical position. The Chinese empire is threatened, both from within and from without; its dismemberment is already being effected and its disintegration is imminent. The Far East has recently become an "arena" that is attracting an increased attention not only from the general public but also from personages in high places, who are responsible for the direction of the affairs of the nations. It has, in fact, been found necessary to recast traditional policy, in many very important matters, and to take into account, for the future, the progress of events in the Far Cathay. The "Gladiators" have already entered the arena, and certain of them have already exhibited their prowess; others are watching, and awaiting their opportunity.

There is a legend about a giant, who while somnolent—overcome by the opiate, with which his wine had been drugged—was dismembered by his enemies. In the case of the Chinese empire, the potion is self-administered; its ingredients will be described. The slumbering giant of the Far East has had many rude shakings, from time to time,

without being aroused, and in modern times the Europeans have forced themselves upon the notice of "The Son of Heaven," insisting, with the support of ships and guns and men, upon being received, even in Pekin. The Japanese David has not slain the Chinese Goliath; but he commenced the dismemberment of the giant, and others have followed.

Korea has been freed from Chinese domination, but only to be at the mercy of the victor, in the inevitable struggle for possession, in the near future. Japan has Formosa—which is proving to be a kind of "White Elephant"—and the Pescadores. She covets also a slice of the mainland, across the Straits; but the French have entered a prior claim thereto. Russia has—with the assistance of France and Germany—ousted the Japanese; and, outwitting the English, has stepped into the Liau-tung Peninsula ports, as a basis for further extension of her sphere of influence, including the regions north of the Gulf of Pechili. France is also persistently extending her zone of "influence" in the south. Germany is in Shantung. Other powers are urging their claims to share in the spoils. Thus the giant is being dismembered. Hydra-headed rebellion throughout the provinces and treason in high places at the capital threaten the alien Manchu dynasty from within; and Chinese history furnishes ample evidence in support of the opinion that prolonged anarchy would follow the overthrow of the dynasty and the collapse of the bureaucracy.

To indicate the possibilities of the future in China, to essay a sketch of the probabilities, and to outline a forecast of the course of events, many factors must be taken into consideration that have very potent influence amongst the governing and other classes of the Chinese; and it may be well to bear in mind that the rulers find it desirable to consult the sentiments of the populace.

The doctrines of Confucius furnish the basis of Chinese education, ethics, conduct, and polity (as generally understood in the classical literature, known to readers in the Occident). But to suppose that Kung fu tze (The master (teacher) Kung) founded a new religion or a novel system, is a prevalent error still perpetuated. Kung was a teacher who selected what seemed to him to be best, from amongst the literature and teaching at his disposal, then already, in his time, B. C. 551–478, considered as ancient, and which may be now called archaic. The noted teachers, authors, and commentators that followed, adhered to the stereotyped, standard ideals of the great master; and thus the Chinese have been at a standstill ever since, intellectually and in many other ways. Conservatism, a strong repugnance to change, is a salient characteristic.

The principal texts have been made accessible to the general reading public of the Occident by the labors of competent translators, and the moral maxims, epigrammatic gems and sentiments contained in them, have not lost much in passing through the able hands that have dealt with them. There is a great deal that claims the admiration of Occi-

dental students. The ability to compile a *réchauffé* of choice selections from the classics is cultivated as an admirable attainment, and success in fitting the "gems" into suitable verbal settings, is an accomplishment that is highly esteemed. The calligraphy has become a fine art. Juggling with fine phrases is the chief pastime of the literati; and writing them elegantly is of more importance than practicing the teachings that they embalm. Certain mental faculties are developed to a very high degree; but the average intellectual calibre of the Chinese, the Hindu, and perhaps the Japanese, form contrasts, although they are all both astute and subtle. The Chinese literati do not stray from the path of rectitude in ignorance of what is right. The biographical legends referring to Kung, and many others who are the cynosure of the literati, inculcate some ideals that are very much open to criticism, from the "up to date" ethical standpoint. They, however, unquestionably exercise great influence amongst the officials, as well as the literati and the populace.

One of the ancient sages retired from the imperial court in disgust and with his wife lived in a lonely valley, passing his time fishing in the mountain stream. The starving woman found his basket empty, as usual, and she noticed that the hook was straightened and without bait; she demanded a divorce. The emperor sent for the sage, who declined to return to the court; but the emperor would not be refused. Subsequently, when travelling in state, he was accosted by a mendicant, who proved to be his scolding wife, and he ordered that she should be provided for. The details of the legend point a moral that modern politicians would not concur in.

It may be mentioned here that the state religion has no connection with the teaching of the Confucian school; it is still what it was before the time of Kung. The emperor formally worships "Teen"—the celestial—on behalf of the people; but it is unlike the cult of the Japanese, it does *not* promote any sentiment of loyalty to the alien dynasty. Confucian teaching, unfortunately for the Chinese, is very much leavened with other theories and beliefs that do not make up for its shortcomings—but quite the contrary. Lao tzu, the reputed author of the Tao teh king, and the founder of early Taoism, was a contemporary of Confucius, although his senior. The school of philosophy—for it was no more at first—founded in the sixth century B. C., is a contrast to that of the Confucians; the followers of these two systems have been, from the beginning, antagonistic in their views. Primitive Taoism may be summarized in the phrase "Masterly Inactivity," the art of neglecting everything. Even activity in a good cause, or in avoidance of evil, is deprecated.

To practice the industries and arts of civilization is contrary to the philosophy of the school and to live in the most primitive state, an ascetic recluse, in lonely places, is the ideal existence. There are similarities in the practices of the Chinese Taoist hermits and those of the

Gaina and other Hindu ascetics. In olden times, many of the recluses were credited with being adepts in the occult arts, and there were resemblances between those of Hindustan, China, and elsewhere, that cannot have been merely coincidences. One of the—so-called—sages is believed to have been able to exhale and project his spiritual ego, which travelled afar, and returned to the meanwhile lifeless body. Another produced from a gourd, phantom horses, upon which the spirit of his colleague often rode. There are many passages in the writings of the early Taoists, that have a fascination for Occidental students; but their influence amongst the Chinese has been enervating. The mediæval writers revelled in paradoxical phrases, that still have attractions for the Chinese literati; and are curious studies, that interest a few Orientalists. The later Taoism is a heterogeneous mass of superstitious beliefs and strange practices. All the occult arts of the Orient are found amongst the Taoist professionals, who reap a harvest, by exploiting them upon the credulousness, the fears and hopes of the populace. Ancestral worship in China, like the *S'raddha* of the Hindus, is the most important feature of the religious life of the people; and the observance of the very exacting demands of the obsequies, and prolonged periods of mourning, bind the people to the locality of the family tombs. Spiritism, the *post-mortem* state, is intimately connected with deceased relatives.

Buddhism obtained imperial recognition and patronage in China; and in A.D. 67, under the protection of *Min ti* (Enlightened Emperor), two *Sramana* arrived at *Loyang*, and were quartered in a monastery on the White Horse Hills. Some translations were made from Buddhist texts. After the middle of the second century A.D., the work of translation proceeded rapidly; and the teachings of the numerous schools of the *Hinayana* (Minor vehicle) and of the *Mahayana* (Major vehicle) were propagated. The quietist school, the contemplative (or meditative) sect, ascetics, and disciplinarians, gained many adherents; and monachism attracted so many, that edicts were issued, restricting admissions to the Order.

The later Hinduism was introduced in Buddhistic forms, increasing the already large number of objects of worship; and from the seventh century, mystic Buddhism gained ground. The Confucian school alone held aloof, and retained its original character; amalgamation took place amongst the other cults; and attempts were made to found eclectic schools of Buddhism.

A legend of the third century B. C. describes "The Bamboo Grove Club of Seven Wise Men," who in troublous times, abandoned their duties in the state and in the family, and retired to an erstwhile imperial retreat, secluding themselves and passing their time in the selfish enjoyment of the four scholarly accomplishments of the literati, viz.: pictorial art and calligraphy; literary composition and reading; music; and games of skill. This is the prototype of myriads of similar coteries ever since.

The thraldom under which the Chinese have always been held, as they still are, through their superstitious fears and hopes, controls their every action to an extent that may appear to be almost incredible; but it is such a very important factor in the influences that sway their judgment, that it is desirable to emphasize the existence of such beliefs and practices amongst all classes—none the less amongst the literati and the officials than the common people. As a consequence of the means adopted to popularize the beliefs and practices that were such a source of revenue to the legions of sacerdotals and charlatans, the admixture of the indigenous and alien cults resulted in the absence of any very pronounced lines of demarcation between the various sects, etc. It is believed that the universe is thronged with invisible beings, good, bad and indifferent, which materialize at times in characteristic forms, some monstrous and horrible, others human, according to their several idiosyncrasies, malevolence, beneficence, or various potentialities. These spiritual beings are supposed to exercise influences, each within defined limits, over the phenomena of nature, and all calamities, national and personal, are attributed to the action of evil spirits, demons and monsters. Eclipses, earthquakes, tempests, droughts, war, epidemics, conflagrations, everything, have special supernatural powers personified, connected with them.

The doctrine of metempsychosis and the theories of retributive justice are not such effective deterrents to evil-doers as their terrors might lead one to suppose. The popular belief in the saving power of the Buddha Amitabha—and that by implicit faith therein misdeeds are forgiven, together with re-birth in the Paradise in the west (Sukhavati)—offers a means of escape from punishment, from expiatory suffering in the purgatories, and from re-incarnations. The pandemonium of the spirit universe—where the valorous guardian divinities, with their legions of converted and enslaved demons, are continually warring against the enemies of humanity—is depicted, with indescribable horrors: as are also the purgatories; the paradises; the celestial regions; the divinities; Buddhas; demons; and monsters. Brilliant colors and gold-leaf are freely used in these very realistic illustrations. Propitiation of the vindictive demons and invoking the aid and protection of the guardian divinities, necessitate elaborate rites, and superhuman assistance is sought, with votive offerings and prayers, in special cases. An innumerable variety of charms, to scare away evil spirits and to attract those which bring good luck, are in constant demand, to the great profit of the vendors. Divination, by means of the eight diagrams, and other more or less simple and haphazard methods, is universally resorted to; and at the fanes of all the cults, means are invariably provided for votaries to try their luck. Astrology, palmistry, and other occult arts, sorcery, exorcism, and other practices, furnish lucrative employment to numerous professionals. The personal judgment is thus set aside at every turn; the conduct is influenced by blind chance and superstí-

tious fears; and the people are at the mercy of designing and unscrupulous charlatans. Instigators of riots work upon these sentiments.

The Chinese have been an agricultural, industrial, and commercial people, from time immemorial, on the coasts and inland waters, a percentage being fisher-folk, and pastoral tribes are to be found in outlying districts; but everything is carried on as in ancient times. The Chinese have never been a warlike people, although the frequent changes of dynasty have been accompanied by wars.

When the present empire was divided into separate States, there were frequent and sometimes prolonged wars between them; and even the succession to the throne has been the cause of war. There is not, however, a warrior caste, like the Hindu Kchattrya and others; or a hereditary class, if the Manchu "braves" be excepted, as in Japan. The Chinese are usually accused of being pusillanimous; but it is a fact that the raw material for good soldiers has been found amongst them. That they are cowardly and cruel—qualities that usually exist together—is very true, under certain conditions; but they have been known to exhibit evidence of possessing the higher moral courage. Brute force is not held to be the best method of ruling, although the officials enforce their will by the aid of the rabble soldiery; and the profession of arms is not respected. The conduct of the Manchu, and other levies, no doubt is mainly the cause of the contempt felt for the army.

The absence of loyalty is only natural, under the oppressive rule of an alien dynasty such as the Manchu, with its rapacious myrmidons and nominees. The indifference as to who may be their rulers, so long as they are left in peace, has been exemplified in the welcome given to Europeans, when assured of just treatment, and protection from the native officials. There is a total absence of national patriotic feeling; for although the Chinese appear, to the transient visitor, on only superficial examintion, to be homogeneous, there are local differences, of dialect, racial origin, customs, and many characteristics; divergencies in custom and other details appear on closer investigation. Quarreling between clans is common, as the police in foreign lands know—the fights between Chinese immigrants in Australia and elsewhere, for instance. The indifference to defeat is remarkable; the soldiers are not pitied, neither are they treated as heroes by the populace when triumphant. There is no enthusiasm or its converse. Ancestral worship tends to preserve the family traditions and history of all classes. The gentry have no hereditary claim to office as a rule, excepting the Manchus. The examinations that are the portal to official appointments are, theoretically, open to all; but the influential literati are men of means and leisure, allied to the gentry. The bureaucracy, principally recruited from the successful candidates at the examinations, frequently lack family influence; and when they are appointed to districts in which they are strangers, there are no ties or local interests. An unpopular

official, making enemies amongst the local influential men, does not have a happy time; to get him into trouble, mobs are incited to create disturbance, missionaries and other foreigners frequently being the victims. The stories of many outrages illustrate this fact. Missionary teaching undermines the influence, and attacks the interests of the literati, the officials, and others who prey upon the people; and adds to the antagonism to any innovation. Foreigners, too, through their consular and diplomatic officials, force upon the attention of the unwilling executive at Pekin, the conduct of the provincial bureaucrats, in a direct and effectual manner, hitherto impossible with the Chinese people, when oppressed. Those in high places in Pekin long resisted being troubled; but they must now give attention to details.

When Europeans forced themselves upon the Chinese at first, the provincial officials were held responsible, and the frequent defeats were never admitted; even when the allies occupied Pekin beyond the actual scene of the operations, the Chinese of all classes remained ignorant of the truth, or would not credit it.

The success of the troops trained and led to victory by Gordon and other British military men, it may be thought, would be an object-lesson, that even the Chinese would be ready to apply practically; but those who have been employed to organize and instruct in China know the facts. The immediate danger past, the Chinese relapse to their traditional policy, and everything is allowed to drift back into the old-time grooves. The lessons of Chinese history furnish grounds for anxiety, it is true. A central military organization might become a danger to the alien hated Manchu dynasty; popular leaders of Chinese armies have, time and again, used their position to overthrow the ruling dynasty and usurp power. Then there is the enormous expense, and the peculation of the officials; and it is considered cheaper to buy off the assailant, than to maintain a costly and dangerous force. The Chinese have been fully aware of the jealousies among the foreign nations competing for favor and for concessions, and have very astutely played them off against each other, using them as opportunity offered. Thus Great Britain had to suppress piracy and protect shipping; and champions the cause of the Chinese now that they complain of intimidation. The introduction of modern ideas has been successfully resisted hitherto: the inland waters closed to steamers; telegraph poles torn down; railway construction and the erection of buildings for machinery resisted; and mobs incited to violence, wherever traders or missionaries attempted to take up permanent residence. It is not so long ago since there was trouble in Europe, under similar circumstances; and the official and press pronouncements of the Spaniards, within the past few months, are not much less reprehensible than the compositions printed and circulated by the anti-foreign Chinese. The tortuous methods of reasoning of the Chinese may be accounted for, by consideration of the influences that have been alluded to; the apparently paradoxical character of their

conduct is explicable by reference to their standard ideals; and the complex puzzle of their characteristics is but a maze of *bizarrerie*, intermingled with pseudo-philosophic theories.

The Occidentals do not care to follow in the same devious path of reasoning as that of the Orientals; and they cannot appreciate the subtleties that attract the Asiatics—especially the Chinese—from the direct course; and the uncertainties, introduced by the practices which have been mentioned, accentuate the other existing difficulties to harmonious mutual good understanding. The obstacles to that coöperation which is so very desirable, are almost insurmountable. An alliance between the Chinese and Japanese presents difficulties; but in one between Chinese and Europeans, especially between Chinese and the British or Americans (either or both), there are great risks. The possibilities of the future of the Chinese empire may be detailed under three or four heads; the potentialities of the country and its enormous population spread over a vast area are illimitable. The perpetuation of the old order of things is no longer possible; there must soon come a change. Revolution is threatened; but vested interests will insure support for the Manchu in Pekin. Frequent local disturbances will have to be reckoned with; but it is possible that revolt may become so general as to paralyze the executive, the strife being prolonged in the remote districts, with repetition of the devastation and horrors of the former rebellion. The overthrow of the Manchu dynasty is possible, if the traitors gain foreign aid; but Great Britain must now be considered as the champion of the *status quo*. The collapse of the dynasty and its bureaucracy would be followed by chaos and disintegration, if it was left to the native rebels to attempt to govern, as there is no possibility of establishing a republic at present, or of placing another dynasty on the throne that would be able to control the provinces. Mediæval history would be repeated, anarchy and prolonged turmoil ensuing. Continuation of the dismemberment that has already made some progress, is possible, although it is being checked; there may be more branches lopped off yet. A protectorate, under a great power, is possible; but all those claiming to share in the partitioning of the remains of the empire, would demand an equivalent.

The awakening of China appears absolutely impossible, if the Pekin and provincial bureaucracy is left to act voluntarily. After the Peace of Shimonoseki, the Chinese were reverting to their old-time torpor; it was the Germans in Shantung, and the Russians in Port Arthur, that aroused them. The Chinese, as usual, when in difficulties, sought advice, which they did not act upon so as to succeed; and begged for aid, against those with whom they were secretly treating—also, as usual, by their duplicity, making it all the more difficult for their friends to assist them. As a desperate expedient, the Chinese are now granting concessions, and making a pretence of initiating a new departure, hoping thereby to enlist the support of the rivals of their most dreaded foes.

There has been keen competition amongst the aspirants for the office of Mentor, and the Japanese have now entered the field; but such a *protégé* (for the Chinese will be found as unreliable and unmanageable in the immediate future as they have been in the past) will be a great responsibility and a serious danger.

Will the British tax-payers assume the burden of fighting the battles of such a people? Will they even sanction the cost of teaching the Chinese to defend themselves? Wei-hai-wei has *not* been occupied solely in the interests of the Chinese. The critics of the policy, of supporting the Turk—the sick man of eastern Europe—which led to the blunders of the war in the fifties, will apply the same reasoning to the case of the Chinese empire, but the circumstances are not quite parallel. In undertaking to champion the Pekin régime, care must be taken to secure guarantees that the Chinese shall not attempt to play fast and loose; and, what is more important still, to insure that they shall be unable to turn round upon their Mentor, when their immediate troubles are, for the time being, settled. With regard to instructing them in defending themselves, in organizing an army, and creating an efficient navy, it cannot be too strongly urged upon the attention of those who will be responsible for the introduction of any such measures, that very great caution will have to be exercised, in creating so dangerous a weapon; and it should be borne in mind, by the irresponsible advocates of wholesale arming of the Chinese, that there is no security against the trained men deserting to an enemy: it is a vain hope to entertain, that such forces would be at the disposal of Great Britain in any emergency. The Chinese, as a nation, under the present régime, will never be a faithful ally.

The Japanese aspire to teach the Chinese to follow their example; but it is very probable that the Japanese would find that they were creating a Frankenstein, in teaching the Chinese to become a powerful military nation. The tradition of the thirteenth-century hero, Yoshitsune of the Gen-ji, identified by some Japanese as Genghis Khan, may arouse visions of conquests, with the aid of Chinese legions. The Japanese, leading myriads of Chinese against the aggressive Europeans is a popular idea that finds frequent expression. To teach the Chinese how to become a great naval and military power, will be beginning at the wrong end. If Great Britain had gained the same footing in China as in, say, Hindustan, or even as in Egypt, there might be some reason for advocating the formation of a force capable of checking the advance of Russia; but there is not the slightest guarantee, or vestige of the possibility of control, as to how the power would be used. The Siberian railway will be completed before any progress can be made in raising an efficient army; a navy is a question of many years, even if a fleet was ordered at once, as its manning cannot be effected offhand. The Chinese bureaucracy, with the Manchu control, could not be trusted; and the idea of preparation for war should be abandoned.

The probabilities are grouped in the problem of the future of the Chinese empire, that is, in its integral form. Preparation for war might make the Chinese officials over-confident, as in 1894; and disastrous defeat would be again the result, inevitably.

England, between Russia in the north and France in the south, with Japan sitting on the fence, and America looking on, maintains a position of "Masterly Isolation"; but will it pay? The open-door policy is very noble, but it is also most thankless. China awaits development, the exploitation of its resources, productions, and labor; and transport facilities, that is, railways and steamers; the immediate opening up of its inland waters while railways are being constructed; and the introduction of modern methods, capital, skill, and machinery. A commencement has been made of late; but the Chinese will be much slower than the Japanese in adopting innovations and foreign methods. Revolutionary changes will be opposed for a long time to come. All hopes for the future of the Chinese people are dependent upon the preservation of peace, and the integrity of the empire is essential to that at present; but the nation which champions the central executive, should be represented by the strongest men that the Mentor can send, and a settled policy should be inaugurated and carried out with a firm and dignified attitude. Where Russia has always the advantage, is that there is absolute secrecy as the foundation of an unswerving policy which is remorselessly pursued.

The astuteness of the Chinese bureaucrat frequently overreaches, and eventually results in disaster. It was thus that the Manchu got a footing and that the Russians ousted the Japanese, to serve their own ends, while England was being outwitted. The lesson is one that should be applied, in attempting to solve the problem of the future of the Chinese empire.

Could Great Britain succeed in securing, at least the acquiescence, if not the cordial coöperation, of certain of the great powers, in the desirable task of maintaining peace in the extreme Orient, the Chinese bureaucracy might be coerced into initiating the most urgently necessary reforms, and they might be further influenced to move in the direction that would be most to the interests of the people. Commencing with the Imperial Court and the officials in Pekin, the provincial bureaucracy might be taken in turn, until the round was made of the departments and provinces. Great Britain has many claims on the Chinese, besides the suppression of piracy, the establishment of the Imperial customs, the suppression of the Taeping rebellion, etc.; and now at last, hearkening to the pleadings of the worried officials in Pekin, their complaints of intimidation have been responded to by a formal declaration of protection. Great Britain has now the right to a voice in the direction of affairs of the nation thus being protected. Responsibilities are being undertaken, involving duties, and it will be a grave error not to use the opportunity to the best advantage. The task is no easy one,

but upon its statesmanlike, conscientious, and courageous fulfilment and its success, will depend the best solution of the problem of The Future of the Chinese Empire.

PERSONAL REMINISCENCES OF THE EVOLUTION OF SMALL-ARMS AND MACHINE GUNS FROM THE YEAR 1863 UP TO THE PRESENT DAY.

By Lieut.-Col. W. N. LOCKYER, R. A., Chief Inspector of Small-arms.

(*From the Journal of the Royal United Service Institution.*)

I.—RIFLES, ETC.

I MAKE the year 1863 the starting point for two reasons:—

1. Because it was just the close of the muzzle-loading period.
2. Because it was in that year that I became personally acquainted with the service rifle, since which time I have continually kept up my acquaintance with the service small-arms, making all kinds of experiments; and for the last sixteen years my duty has been to inspect and test the various arms during their manufacture, after they are finished before issue, and again when in use in the hands of the troops.

In the year 1863, the muzzle-loading long Enfield was, generally speaking, the service rifle. The navy, rifle battalions, and sergeants of infantry were armed with the short Enfield, and Royal Engineers with the Lancaster carbine, which had a smooth oval bore, firing the same bullet as the Enfield.

The Enfield rifle was designed at the Royal Small-Arms Factory, Enfield, and although the first pattern was dated 1853, it can hardly be said to have been finally adopted until 1855, when some of these rifles reached the army before Sebastopol, who had been previously armed with the Brown Bress and Minié rifle.

The calibre of the rifle was .577, rifled in the three grooves, the twist of the rifling being one turn in 6 feet 6 inches, or about half a turn in the length of the barrel.

The bullet was .568 inch in diameter and weighed 535 grains, and the charge of powder was 2½ drams for rifles and 2 drams for carbines. The bullet loaded easily, and on firing was expanded into the grooves by a clay plug, the frustum of a cone inserted in the base. The bullet and powder were contained in a paper case; to load, the loose end of this was torn off, the powder poured into the barrel, then the case was reversed, the bullet inserted in the muzzle, the empty case broken off, and the bullet rammed down. We were always taught as boys to wet the bullet before putting into the rifle, I don't know why; but I remember the taste of the lubricant. The percussion cap was a curious-looking

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one, like a tall hat with the brim split into four parts; one of these parts was bigger and longer than the others; if you put this long part towards the front of the rifle you were safe, if you did not and the cap burst (which it very often did) minute pieces of copper were driven into the little finger of the left hand, and though you did not feel it much at the time the pain and irritation afterwards were considerable, and I carry the scars to this day on my little finger from this cause. I have heard since that one of the flanges of the cap being bigger than the rest must have been accidental, as they were intended to be the same size; but it certainly was the case with those we had. The cap was very strong, and it was a common game for boys when waiting about on the range to put the little paper cones in which the caps were done up on the muzzle of the rifle and then fire a cap, when the paper cone would be blown off to some distance. A sad event happened at one of our public schools about this time. The boys were waiting to shoot, when one of them took up a rifle, put on the little paper cone and a cap, saying to one of his comrades, "Let's have a shot at your hand"; he fired, but the rifle was loaded, the bullet passing between the fingers of the boy without hurting him, but hit another boy standing behind and killed him.

In 1863, and the three following years I shot for my school at Wimbledon. In those days there were only two military positions, standing at the short ranges and kneeling at the long. Some very wonderful standing shooting was done then, and I remember at Wimbledon one of the Ross's (I think Edward) backing himself to make a large majority of bull's-eyes standing at 200 yards, the bull's-eye being a 9-inch circle. I think, but am not quite sure, that it was 70 bull's-eyes in 100 shots, but I remember he won easily.

The match or small-bore rifle in those days was generally the Whitworth, which had a mechanically fitting hexagonal bullet. The position was prone; the back position did not become popular until some years after.

The match-shooting was a tremendous business. The rifle was carefully cleaned and wiped after each shot, the shooter having a case like a medicine chest, containing, amongst other things, a row of little glass bottles, each bottle containing a carefully weighed charge of powder.

Although the Enfield rifle had a low velocity, 1240 feet, and very high trajectory, in class shooting one had to shoot up to 900 yards and off the knee. The conditions for marksmen were: Five shots at 650, 700, 800, and 900 yards, target was 12 feet long by 6 feet high, bull's-eye 4-foot circle. Bull counted two, rest of target one, and it was necessary to make seven points in the twenty shots. I remember well the first time I was a marksman as a boy I made three points at 650 and two at 700, missed all five at 800, so had to make two at 900 to get the badge. I never thought there was the least chance, but my first shot at that range was a bull, and I don't think any of the others hit the butt.

In those days you only fired one shot at a time, then retired to the

rear to load, and waited for your turn again after the whole of the rest of the squad had fired a shot.

By the introduction of this rifle a very great stride was made, and accuracy of infantry fire at considerable ranges began to be looked for. After some experiments had been carried on with it, a very high authority declared it to be the most effective weapon ever placed in the hands of a soldier, and that its introduction and the teaching of dexterity in the management of it had effected a reform far greater in its bearing than any that had been made since the first introduction of fire-arms.

In 1860 another immense stride was made, as since that date all small-arms have been made strictly interchangeable; that is to say, the various component parts of a dozen rifles of the same pattern might be mixed together, and they could then be assembled easily into a dozen arms. I consider this one of the most important epochs in the evolution of our small-arms.

Up to this time we had merely toyed with breech-loaders, and that principally with regard to their use by cavalry. Carbines on Westley Richard's, Sharp's, and Terry's systems were introduced to a limited extent.

The first military breech-loader I ever saw came in about this time, the Westley-Richards' carbine. It was a half-and-half sort of thing; the bullet and powder (the latter contained in a thin case and attached to the bullet) were inserted into the breech, and it was fired with the ordinary cap. I don't remember if it shot well, but I recollect having a shot or two with one, and getting covered with grease from the cartridge.

In August, 1864, it was decided that steps should be taken to arm the British infantry with breech-loaders, and the first step was to find a system to which our stock of Enfields could be easily and cheaply converted. After the trials of various plans, among which was the Soper, to my mind a very excellent system, the Snider was adopted in 1866.

The conversion was carried out by cutting off a portion of the breech and fitting in its place a hinged block forming a movable breech. The nipple was of course done away with, and for the first time a cartridge carrying its own means of ignition introduced. All our stock of rifles and carbines were converted.

The barrels of the old Enfield were made of wrought iron, but when new Sniders were made steel was used; the old wrought-iron barrels were very good, and I cannot help thinking that the iron ore in those days was better than it is now; one thing is certain that the wood of which the old Snider stocks were made was better than any wood we get now. The Snider had a low velocity (1240 feet) and had a high trajectory; but it was in many ways a most serviceable weapon, and very fairly accurate up to 500 yards, in fact, I have heard many good shots say that they preferred it to the Martini at 200 yards on account of the

comfortable stock. The bullet was a very formidable one—it had a large hollow in the head, and on striking flesh opened out, inflicting a most ghastly wound, and its stopping power was undoubted, though I never heard any questions being raised about it as we have recently heard about the Dum Dum, and other stopping bullets. The cartridge left much to be desired, and if it got damp, the outside paper had a nasty habit of rucking up, and of course the cartridge could not then be got into the chamber.

Immediately after the approval of the Snider, which was really only a stop-gap, steps were taken to seek out the best pattern of breech-loading rifle for future manufacture; and in response to an advertisement from the government a large number of different descriptions of arms were submitted; many of these were at once rejected, and finally, after exhaustive trials, the Martini-Henry (so called because it embodied the breech action of Martini, an Irish gunmaker, and the rifling of Mr. Henry, of Edinburgh) was introduced in 1871; this was a great stride; the diameter of the bore was reduced to .45 inch, it was rifled with seven grooves, twist 1 in 22 inches; the cartridge was much improved, the charge was 85 grains powder, and 480 grains bullet, the velocity increased to 1315 feet, and the trajectory lowered, consequently the accuracy of the rifle was much increased, and it was very fairly accurate up to 900 yards. But the great feature, to my mind, was the action; the first was not quite satisfactory in this respect, but improvements were made until finally the action of the Mark II. and Mark III. Martini-Henrys was, and for that matter in my opinion is, the best military breech-loading action in the world. It would stand an immense amount of rough usage and knocking about without getting out of order, and I have an interesting relic testifying to this fact. An attempt was made some years ago to blow up the White Tower at the Tower of London; the charge was placed in a dark corner of the armory, and on exploding dug a little out of the wall, but shattered an immense amount of glass, and blew the adjacent Martini-Henry rifles all over the place. It was part of my duty then to visit the armory at the Tower periodically, and I went there the day after the explosion; on going to the armory I saw a rifle hanging from the ceiling—it had been driven straight up and the muzzle forced through the lath and plaster. I had it taken down and found it broken and bent in all directions, but although even the trigger and most of the lever have disappeared, the action is uninjured and will still work.

The Martini-Henry carbine had a special cartridge with a lighter bullet and reduced powder charge, and with this its ballistic qualities were not so good as the rifle; it would fire the rifle cartridge well, but then the kick was severe, and almost prohibitive. I can stand heavy recoil as well as most people, but after firing ten or a dozen rounds with this carbine and rifle cartridges my shoulder used to feel a bit stiff, and I can quite imagine it hurting a thin man a good deal.

The Martini-Henry was a good target rifle, and 100 points and over out of a possible 105 have been often made with it at 200, 500, and 600 yards, seven shots at each distance.

The principal match rifle of this period was the Metford, by different makers. It had the Metford rifling, a very heavy barrel, a heavier bullet than the Martini-Henry, and generally a slightly larger bore. The shooting made with these rifles, fitted with wind-gauge match-sights, and fired in the back positions was wonderful ; and I think I am right in saying that at 800, 900 and 1000 yards with 15 shots at each range, as many as 220 points have been made out of a possible 225.

The Martini-Henry was an excellent servant, and remained practically the service weapon until the year 1888 ; but during this time many experiments had been carried on at Enfield with small bores ; some .350 rifles were tried, and eventually a large number of .4 bore rifles were made. These still retained the Martini action, with a longer lever to facilitate extraction ; but they were never issued in their original form, and when a still smaller bore was decided on they were fitted with .450 barrels, and known as Martini-Henry, Mark IV.

It also became necessary, in order to keep pace with European nations, to introduce a magazine in connection with the rifle, and this caused a radical change in the breech action of our rifle. A large number of designs were submitted, and tried, by various individuals, to make a magazine which would be applicable to our dear Martini falling block action. It is needless to trouble you with a description of any of these ; it suffices to say that none of them were found suitable, and it became evident that if we must have a magazine rifle it was necessary to make a fresh departure, and abandon the falling block for the bolt. Time will not admit of going into the comparative merits of the two systems ; personally, I like the block action much the best, and I have never been convinced of the necessity of a magazine ; but as this was considered a *sine quâ non*, a bolt had to be used, and after a large number of trials of various kinds the Lee bolt was introduced.

It was at first intended that whatever magazine rifle was adopted should retain the .4 calibre, but in consideration of further experiments with smaller bores, and the introduction by Major Rubin, of the Swiss army, of a hard-coated bullet, the question was reopened. This kind of bullet got over the difficulties of " stripping " and " leading," which had hitherto interfered with the introduction of a smaller bore, and consequently quicker twist ; and eventually the .303 bore was decided on with the Metford rifling.

The Lee-Metford was manufactured and issued in 1888. The bore was .303 inch, rifled with 7 grooves, with a left-hand twist of one turn in 10 inches. I could never quite make out why a left-handed twist was advocated, but I have heard it had something to do with counteracting the rotation of the earth. It fired a bullet 215 grains, which had a lead core and nickel envelope, with a black powder pellet of 77½ grains con-

tained in a solid-drawn brass cartridge case. This case caused a good deal of trouble at first, as it was difficult to find the exact alloy which gave the right amount of hardness and elasticity to the case; if too soft, on the explosion it swelled into the chamber and would not extract; if too hard it cracked, and there was a nasty escape of gas at the breech; this however, was soon got over. The rifle with this cartridge had a velocity of 1800 feet, and a low trajectory.

When the manufacture of the Magazine Lee-Metford, as it was called, was in full swing, and after issue to the troops, many improvements and alterations were made, such as the enlargement of the magazine to hold 10 cartridges instead of 8, the introduction of "safety" or "locking belt"; about the necessity of this latter there was much difference of opinion, and other details.

The ammunition was also altered, and cordite substituted for the black powder pellet, which was of course a most important change, and finally the Metford grooving was changed to the Enfield, which, without altering the ballistic qualities of the rifle, added considerably to its life.

The present rifle with cordite has a muzzle velocity of 2000 feet and very low trajectory. It is a remarkably accurate weapon, as was found last year at Bisley when it was used for the first time by the Volunteers as their service weapon; the enormous number of highest possible scores made must have been a distinct cause of trouble to the Executive of the N. R. A. In that year the match-shooting at Bisley was restricted to .303 rifles, and at the long ranges the scores fell off considerably, as any change of wind affects the comparatively longer and lighter bullet, much more than the heavier bullet of the old .45 rifle.

When the introduction of the magazine rifles was decided on, a number of Martini-Henry rifles were under manufacture by contractors, and it was settled that they should be completed to the smaller bore, so as to fire the same ammunition as the magazine rifle. The outcome of this was known as the Martini-Metford, Mark II. This was a fine shooting weapon, but as the exterior of the barrel was the same size as the Martini-Henry it was heavy and not well balanced. Some of these were issued to the colonies.

The rifle known as the Martini-Enfield has the same sized barrel as the magazine rifle, and a large number of Martini-Henrys have been converted to this pattern by the substitution of this barrel and suitable fore-end.

This weapon was offered to the Volunteers, but they wanted the magazine rifle, and their wish was acceded to; I think their choice was an unwise one, for the Martini-Enfield is a beautiful weapon, light, handy, well balanced, an excellent shooting arm, and is to my mind the finest military rifle in the world.

A very large number of carbines with .303 bore have been made, some converted from Martini-Henry rifles and carbines, retaining the Martini action, and many Magazine Lee-Metford and Lee-Enfield car-

bines. It may surprise you to hear that there are as many as 14 different patterns of .303 carbines now extant, of which about nine are in the service. These carbines are excellent weapons and extremely accurate.

We have now but one description of cartridge for all .303 rifles, carbines, and machine guns, a very great advantage from a store and supply point of view; and this brings me to one of the points which I am anxious to hear discussed, and to which I would ask you to give your careful attention.

It has for a long time been my great desire to see one universal pattern of fire-arm in the hands of all services, and the weapon I am strongly in favor of is a carbine, fitted with a triangular bayonet with a sword hilt. I will take the principal points to be considered and compare the two weapons, when I think I can show that the comparison is distinctly in favor of the carbine.

1. *Ballistic Qualities.*—The velocity of the rifle is 2000 feet, that of the carbine at present about 100 feet less; this, however, could be increased, I fancy, if necessary. It must be remembered that now the carbine fires the same cartridge as the rifle. In the Martini-Henry days, although this was possible, the kick rendered it almost prohibitory, while the special carbine cartridge rendered it a far less powerful weapon. Now, of course, there is practically no recoil with either weapon.

2. *Accuracy.*—Fired from a machine rest, this, at 500 and 1000 yards, is about the same for both weapons, the carbine having a bit the best of it, probably because the shorter barrel of the carbine has less whip than that of the rifle.

The carbine is without doubt a more difficult weapon to make absolutely accurate target practice with than the rifle, not on account of any want of accuracy, but because of the shorter radius, that is, the distance between the two sights; but if absolute accuracy for target shooting is considered necessary for a service rifle, we ought to have the old match-shooting .45 bore, with all its paraphernalia of wind-gauges, etc.

But there is very little bull's-eye shooting on service, and on service I believe the carbine would be the better shooting weapon of the two.

Some carbines made after this pattern were sent down to Hythe to be fired in comparison with the rifle, and I quote the following from Colonel Paton's report:

Volleys were fired by ten men, some of whom were young soldiers, at a target 30 feet square.

At	1000	yards	the	rifle	gave	89.50	per cent. of hits.
"	"	"		carbine	"	87.81	" "
"	1400	"		rifle	"	67	" "
"	"	"		carbine	"	69	" "
"	1600	"		rifle	"	55	" "
"	"	"		carbine	"	48	" "

Now it must be remembered that these men had practised for some

years with the rifle, and had never fired with the carbine. Colonel Paton said that some of them had never seen a carbine before, and the carbines having been made in a hurry were never accurately sighted. There is very little in favor of the rifle in these trials, in fact, at 1400 yards, the carbine beat the rifle; and I am confident that, the conditions being equal, and the men knowing the carbine as well as the rifle, the former would beat the latter at long-range volley firing.

It is much easier to fire steadily with the carbine than the rifle at long ranges, as the back-sight of the former is so much lower than that of the latter, that the excessive straining of the muscles of the neck to look over the sight is not necessary.

3. *As a Pike with Bayonet fixed.*—This is generally advanced as a strong reason in favor of retaining the rifle, but if you go back to the old triangular Martini-Henry bayonet fixed to a cross handle like the present little knife, the advantage in length is in favor of the carbine, while the lightness and handiness of the carbine with this bayonet make it a far more efficient pike than the rifle and small sword-bayonet. I cannot like the present sword-bayonet as a bayonet, and when unfixed it is well-nigh useless as an offensive weapon. The bayonet I propose is as I say the old Martini-Henry triangular with a cross hilt, a more efficient and smarter looking weapon than the present little sword-bayonet, both on and off the carbine.

I may remark that we have a large number of these bayonets now in store, and these would only require to be fitted to the cross hilt to be utilized.

4. *Weight.*—The average weight of the rifle is 9 lbs. 4 ozs. This carbine is 7 lbs. 7 ozs., giving an advantage to the carbine of nearly 2 lbs., which would allow of that extra amount of ammunition being carried by the soldier if wanted.

5. *Handiness and Portability.*—This is, of course, the great and, to my mind, very important point in favor of the carbine. The carbine is some 8 inches shorter than the rifle and can be carried slung with ease and comfort, leaving both hands free; the importance of this for engineers, mounted infantry, navy, and marines engaged in boat work, and for all troops engaged as ours generally are on a campaign in a difficult, mountainous, or jungly country, cannot be overestimated. The rifle is very much in the way and very uncomfortable when slung, the carbine is not, and when carried in the hand or on the shoulder is very much handier and, of course, lighter than the rifle; and I don't think any of us would take a magazine rifle out for sporting purposes if one of these carbines was available.

6. *Ease of Cleaning.*—This again is much in favor of the carbine: there is less surface to clean, and on account of the shortness of the barrel it is easier to see when it is clean.

7. Lastly, if this plan were adopted there would be one pattern of arm for all services, which would be a very great step indeed.

It would simplify supplies of components, arm chests, vocabularies of stores, and storekeeping to an immense degree.

These are the most salient points that occur to me, and I must say I should like very much to see a few of our regiments armed with carbines as I propose, so as to give them a trial. The change at first sight may appear startling and meet with disfavor, because we are imbued with the idea that a carbine must be an inferior weapon; but when people get to accept the fact that this is not the case, the immense advantages possessed by the carbine must have weight and it will be adopted. Since writing this paper I see that the Austrians have partially armed their dismounted troops with a carbine.

You will see that the carbine with bayonet fixed has at all events a very smart appearance.

Before leaving the subject of the rifle, I should like to say a word about our bullet and bore. The service bullet in use up to the present time has not given complete satisfaction, as it is somewhat lacking in stopping power; of course, a hard bullet travelling with great velocity has great penetration, but this very penetration prevents it from giving a great shock unless it strikes a large bone or pierces the heart or brain.

If you fire a bullet through a window it makes a neat little hole, but if you throw a soft lawn-tennis ball at it the shock to the window is very apparent. As an instance of the effect of a small bullet, I may mention that some years ago we had an accident at Enfield with a Morris tube; a man was shot with a bullet from one; it went in close to the backbone, and pierced one of his kidneys and his liver, coming out in front, and lodging in a gymnasium belt he was wearing. If this had happened in a fight, I very much doubt if the man would have known anything about it, and it certainly would not have stopped him; he walked to the hospital, and I saw him a few minutes after; there was no external bleeding, but of course his interior economy was damaged, and he took some time to get quite well; but he is still at work at Enfield Lock; and as I hear he took part in some rowing matches at Easter, there cannot be much the matter with him.

Now there is no difficulty in making a stopping bullet for the .303; that has been known for a long time; it is, however, rather difficult to do so without interfering with its accuracy; but the chief difficulty lies in the amount of stopping power we are allowed to use in European warfare; we want a bullet which will stop our enemies but not hurt them too much; how much we may hurt them I don't know, but I do know that the Snider bullet hurt a very great deal and nothing was said about it. I also imagine that the Afridis, Dervishes, Zulus, and such like, who require a good deal of stopping, do not know much about the "Declaration of St. Petersburg"; on the other hand, I think that a European soldier who gets a plain unadulterated .303 bullet through him will fancy he has earned his day's pay and take a rest.

I do think, however, that evolution, as far as regards the size of the

bore and bullet, has gone far enough, and I trust that we shall not attempt anything smaller; if we do, we shall have to go back again to the Metford rifling, as I do not think the Enfield would stand the sharper twist necessary for the reduced diameter. The bullet also would lose, not only in stopping power, but in accuracy at long ranges; some of the Continental small bores I have tried lately are so affected by any slight change of wind that it is impossible to get accurate shooting out of them on anything but a perfectly calm day, even at 1000 yards.

II.—PISTOLS, SWORDS AND BAYONETS, AND MACHINE GUNS.

I had little experience of the heavy single-barrel muzzle-loading cavalry pistol formerly in the service. In 1864 we had two muzzle-loading cavalry pistols in the service, one with 8-inch and the other 10-inch barrel. They were rifled in five grooves, of the same bore as the Enfield rifle, and fired the same diameter of bullet, weighing 390 grains. No doubt its bullet was effective if it hit anyone; but the following anecdote, which was told me in India many years ago of a cavalry regiment with which I was stationed, tends to show that it must have been, to say the least of it, erratic:

Every cavalry regiment had to fire a certain amount of pistol ammunition at the target every year, and on the occasion referred to a party had been marched to the range by the orderly officer, and began to fire their pistols at the target; the officer retired to a shady corner to read the paper, leaving the firing party in charge of a N. C. O. The officer was disturbed by the N. C. O. coming up and reporting: "I beg your pardon, sir, but I have to report that Trooper Harris has just hit the target. What is to be done?" The officer was puzzled and then said: "Done? Why, do you think I ought to put the beggar in the guard-room?"

There were also other pistols in the service with which I need not trouble you; some of these had movable stocks, so that they could be used as carbines. The navy also had a smooth-bore pistol.

The Adams revolver, which came into the service in 1868, was the first military revolver with which I had much to do. It was a solid-frame pistol, that is to say, the frame was rigid, and after firing the empty cartridge shells had to be punched out with a hinged ramrod. It was not a very powerful weapon, carried a bullet of 225 grains, with a charge of 13 grains of powder. There were no particular points of interest about it, but it remained for some years in the service, being gradually replaced from the year 1880 by the Enfield revolver.

This was a considerably more powerful weapon. It carried a bullet of 265 grains, with a charge of powder of 18 grains. It was a self-extractor, that is to say, after firing, the empty shells were extracted by the mechanism of the pistol. It was rather a clumsy weapon, and though it shot fairly accurately as far as grouping went, yet it threw so high that it was necessary to aim at 20 yards very considerably below the point you wanted to hit.

In the year 1886 the Duke of Cambridge and Lord Wolseley (then Adjutant-General) visited Enfield, and the latter, when talking about pistols, said: "Would it not be possible to have a short light revolver, of about 2 pounds, which would shoot straight and hard?" I said (I was Captain-Inspector then at Enfield) I thought it would; and on the next day began experiments, in which I was assisted by Mr. Speed, who was then head viewer, and is now manager at Enfield.

We used an old Tranter pistol to experiment with. To have a lighter pistol it was necessary to shorten the barrel and cylinder.

Now it is manifest that the powder gas does not work on the bullet after it has left the cylinder, and at first it appeared as if the bullet would be gone out of the cylinder before much powder was burnt. It then struck me that by choking the end of the cylinder the bullet might be restrained until a considerable amount of powder was burnt and then delivered into the barrel, which should not squeeze it any further, but simply communicate the spin.

We could not choke the end of the cylinder, but we got some Enfield pistol bullets and filed them to different sizes, until we arrived at a size which gave most satisfactory results, and we found that our little pistol not only shot hard, but straight at the point aimed at.

I reported these results to General Arbuthnot, who was then Superintendent, and then, in conjunction with Mr. Henry Webley, I worked out the dimensions and weight of the Webley revolver; of course I had nothing to do with the mechanism of the pistol, which was Mr. Webley's patent.

Some of these pistols were made, tried and liked, and in the year 1890 were issued to the service, and I think on the whole have given general satisfaction. The pistol has been much improved from time to time, and this one, a Mark III., is much superior in detail to the Mark I., though the dimensions and general principles remain the same.

It is a powerful little weapon, and shoots strongly and accurately.

Now a pistol is eminently a short-range weapon, and should most undoubtedly fire a stopping bullet, which should at all events knock a man down; this the original bullet did not always do, it had too much penetration, and unless it hit a bone would go right through and not stop a man for a certainty. For some years I have been advocating a stopping bullet, and have advised my friends when going on service to bore a large hole in the front of their revolver bullets; this, of course, materially adds to stopping power, but Mr. Webley's stopping bullet is far superior to this.

It is a cylinder with a conical hollow at both ends; it has quite enough penetration, but on striking flesh opens out and gives such a shock as will certainly stop any man.

Many kinds of magazine pistols are before the public, but all I have seen, though very accurate, are complicated, and fire much too small and light a bullet to be serviceable.

One of the advantages claimed for these high-velocity pistols is that they will kill a man at 500 yards; my rejoinder to this is, a Webley pistol will kill a man at 800 yards, if you hit him in the right place, for some of you may be surprised to hear that the extreme range of this little pistol as taken at Shoeburyness is 1578 yards.

Some appliances have been brought forward for the quick loading of revolvers, but I cannot think they would be much use on service; a revolver would generally be used in a rush or *mêlée* when there would be no time to reload in any case, and if there was time the few seconds longer which it would take to load from a pouch would not be of much consequence.

A cordite cartridge has been made for this pistol, and gives good and satisfactory results.

The bore of the pistol is .441, the size of the bullet .450. It will also fire the .455 bullet.

SWORDS AND BAYONETS.

There have been so many changes in these weapons, and at the same time each change has been so slight that it would be wearisome to enumerate them, suffice it to say that since 1863 the pattern of the cavalry sword has changed five times.

We have always been seeking after a perfect cut and thrust cavalry sword, but an ideal weapon of this description is difficult, I might almost say impossible, to obtain. A perfect cutting weapon will not be a good thrusting one, and *vice versa;* in 1887 the German army seem to have given up the attempt, and their weapon of that day is a thrusting sword and nothing else.

In the year 1887 Messrs. Kirshbaum and Co., of Solingen, were making 1885 pattern cavalry swords for us; and swords for many other European nations. I am aware that there was a considerable outcry as to our obtaining swords and bayonets from Germany, and that to this fact were attributed by many the causes of complaint which had arisen in regard to these weapons in our service. I am satisfied that this idea was entirely groundless. Solingen had been for centuries the manufactory of swords for the greater part of Europe, and for the excellence of the weapons produced could not be surpassed; while we had certainly then, as now, not more than two or three manufacturers in England who turned out swords in any quantities.

An extraordinary idea was at this time generally prevalent, which was that no matter what test or treatment a sword was subjected to, under no circumstances should it take a permanent bend or set. Nobody seemed inclined to complain should the blade break—that proved that it was "good steel," but if it retained a bend, under any circumstances, it was at once put down as no better than "hoop iron." Notions had evidently changed from Shakespeare's time. He tells us that on Henry V.'s return from France, his Lords desired him—

"To have borne
His bruised helmet, and his bended sword
Before him through the city."

They evidently thought that having a "bended sword" was a credit to a soldier, as proving the good use to which he had put it. If they had lived in 1887 they would have had the maker and the inspector—especially the inspector—hanged.

It must be remembered that a sword is after all a bundle of longitudinal steel fibres, and if it is bent beyond its "limit of elasticity," if of high temper, some of these fibres will break; if the bending is continued the sword will snap in two.

In the same way, if the sword is of low temper, the fibres will bend when overstrained and not recover their straightness, and the sword will remain bent. I had for some time been certain that our swords were being over-tested, and many of them much injured before being issued into the service, as they were subjected to a very severe bending test. Now, though a sword may stand this very severe test once, it runs a chance of being so over-strained thereby and so injured as not to be able to stand anything afterwards.

On one of my visits to Solingen, I had an opportunity of comparing the various tests to which the swords of different nations were subjected, and the result was that I found our tests infinitely more severe than those of any other nation. Our view-room at Solingen was known as the "Chamber of Horrors," and this was at the very time when the responsible authorities were being clamorously assailed for not insuring that our weapons were sufficiently tested. On my return on this occasion I wrote a strong report on the unwise severity of our tests to Colonel King-Harman, then the Superintendent at Enfield, who forwarded it, fully endorsing my views. Shortly after this the testing of our swords and bayonets was revised, and the tests all modified, so that those to which each description of sword or bayonet was subjected should be well within the limits of elasticity of that particular weapon. Swords and bayonets have suffered much, and much trouble has been given by amateur testing, and it would surprise you to hear some of the severe strains that these unfortunate weapons have been expected to stand.

Soon after the sword and scabbard was first carried attached to the trooper's saddle, the following incident occurred:

A trooper dismounted, and allowed his horse to get away; it lay down and rolled in the hard road over the sword and scabbard. The very natural and certain consequence was that the sword and scabbard was so bent that the sword could not be withdrawn from the scabbard; there was a considerable fuss about it, and it was said that our swords and scabbards ought to stand this test; all I can say is that they don't and never will. I could recount several similar cases.

Again, on several occasions complaints have been made that swords have been notched at drill, and on inquiry it has been found that one

man held a sword while another cut at it. Now, when the edges of two swords meet violently in this way, one of them must be damaged, and the weapon that will stand this test has yet to be invented. At the present moment we are in a peculiar position with regard to swords. The infantry want a perfect thrusting sword; the navy want a perfect cutting sword; and the cavalry want a perfect sword for both cutting and thrusting.

As regards bayonets, they have been, roughly speaking, of two kinds, triangular and sword.

With the long Enfield we had a triangular bayonet 1 foot 5½ inches long, which when fixed made the weapon about 5 feet 11½ inches as a pike; there was a little difference, of course, between the long and short stocks; the navy had cutlass sword-bayonets for their short rifles, making them when fixed 6 feet 3 inches in length. Short rifles and carbines of the army, with the exception of cavalry carbines, had sword-bayonets. This state of things continued with the Snider; but when the Martini-Henry was introduced, it being a little shorter than the Snider, the Martini-Henry bayonet 4½ inches longer than the old bayonet was introduced, bringing the length of the pike again to 5 feet 11½ inches.

So far the evolution of the bayonet from earliest times when it used to fit into the muzzle of the musket is plain enough, but the evolution of the universal knife-bayonet has always puzzled me. It was, I believe, copied from the one in use in the German army. But I think there can be no doubt that for bayonet work the old triangular bayonet Martini-Henry was, and is, the best; it will go in and come out easily; and, fitted with a cross handle, as the one I propose, it is an effective weapon when unfixed; while the little knife-bayonet makes an inferior pike, and as a weapon when unfixed it is well-nigh useless.

There seems to have been a change in opinion of those in authority as to the necessity for the length in "push of pike," for the length of the Lee-Enfield rifle, with knife, is only 5 feet 1½ inches. The carbine I propose with Martini-Henry bayonet is 5 feet 1⅝ inches long. The Snider and Martini-Henry were, as has been said, close on 6 feet.

Prior to the introduction of the present universal pattern knife-bayonet many different kinds of sword-bayonets have been in use for various carbines and short rifles; of these some were good, some indifferent, and some downright bad. Time will not admit of discussing them.

MACHINE GUNS.

For some years experiments have been made on machine guns, but the first machine gun in our service was the Gatling, introduced in 1875. There were two sizes of these, one of .45-inch calibre and one of .65-inch. Each gun had ten barrels fixed in circular discs. This ring of barrels was revolved by turning a handle, and each barrel discharged in turn when it arrived at a certain position. The gun was ingenious, fired about 450 rounds a minute with considerable accuracy, but was very heavy, complicated and easily put out of order.

In 1882 came the Gardner guns—there were five-barrelled, two-barrelled, and some one-barrelled; these were of rifle calibre. The two-barrelled gun may be taken as the typical Gardner gun, and we have a large number of these in the service. Its action was extremely simple, and the parts few and strong. It fired, by turning a handle, at the rate of about 300 rounds a minute.

The first Nordenfelt guns came in in 1878, and were of two natures—one firing rifle ammunition and one firing a cartridge with 1-inch steel projectiles, for use in the navy only.

There were many different patterns of the rifle bore—three, five, and ten-barrelled—and many improvements were made in the action, and the latest mark had certainly a beautifully-designed and fitted action, which could very easily be taken to pieces without the aid of any instrument. The five-barrelled gun may be taken as the type of these, the action of all of them being the same. It is fired by the horizontal backward and forward motion of a lever, and at the rate of about 500 shots a minute.

There were some .4-inch bore guns made of both Gardner and Nordenfelt pattern, and some of these latter are still in India. In comparing these three guns—Gatling, Gardner, and Nordenfelt—I think it may be said that the Gatling was the most accurate; the Gardner the most simple; and the Nordenfelt the easiest to work. I confess myself that I have always had a sneaking preference for the two-barrelled Gardner, on account of its great simplicity, and consequently on the great ease with which any damaged part could be replaced, and also on account of its certainty, for it seldom got out of order.

I do not think that our noble Chairman agrees with me, for I fancy the five-barrelled Nordenfelt was his pet gun, and it certainly did yeoman service with him up the Nile in 1884.

The cartridges of these three natures were contained in hoppers, fed into the gun, more or less, by the action of gravity. A Mr. Accles invented an actual feed for the Gatling gun, but I do not think it was altogether a success, and only 14 were issued.

I may mention here that in consequence of the idea that the bottle-shaped cartridge for the Martini-Henry rifle would not load well into a machine gun, a special form of chamber called the "Gatling-Gardner" chamber, which took a cartridge with a less pronounced shoulder, was introduced into the earlier .45 machine guns, and that chamber is still continued in naval .45 guns, even Maxims, although the Martini-Henry chamber was introduced for .45 land service guns. The consequence is that while the land service guns fire Martini-Henry solid case cartridges, the naval guns will not do so, but have a special cartridge.

We now come to a great step, the introduction into our service of the Maxim automatic gun. I need hardly say that an automatic machine gun is one which loads, fires, and reloads itself as long as the trigger or firing-lever is kept pressed down and the gun is fed with cartridges. The great advantage of this class of gun is that a rapid stream

of bullets can be directed at a moving object, or quickly changed from one point to another by casting loose the traversing and elevating gear, and using the gun like a fire-hose. Now this cannot be satisfactorily done with a gun which is actuated by working a lever, as the rotatory or reciprocating motion of the lever would quite derange your aim if the gun were not held by the elevating or traversing gear.

Mr. Maxim submitted various patterns in the year 1886, and he will forgive me for saying that his inventive genius nearly drove me frantic at this time, for no sooner did I think that the pattern was finally settled than he would be down again at Enfield with two or three more guns, all with various improvements, and the whole thing had to be done over again.

At last the pattern was definitely settled, and the first Maxim guns were issued in 1887. The gun has been improved in various mechanical details, with which I need not trouble you.

The weight of a Maxim gun, both .45-inch and .303-inch, is 60 lbs., which shows what strides have been made in machine-gun construction in the last twenty years, since the first machine gun introduced, viz., the Gatling weighed 416 lbs., and fired 30 per cent. slower.

The principle of the gun, as you know, is one of recoil, that is to say, the recoil of the barrel after each shot is made use of to load and fire the next one.

The .450 calibre gun, with black powder, worked well and gave much satisfaction, but when the .303 bore was introduced and cordite, there being very little recoil, a great difficulty had to be encountered, and I confess that I looked upon the first .303 guns that were made with much suspicion, and there was certainly a good deal of difficulty in getting them to go with any degree of certainty. But improvements have made the action of this gun pretty certain. It fires from 450 to 550 rounds a minute, and of course, it is of great advantage to be able to use smokeless powder with a machine gun.

I am afraid the dearest friends of the Maxim gun can hardly call its action simple, and every single part of the action has to be very minutely gauged. Even after passing these minute gauges sometimes the gun will not work, and it is difficult to find out why not. We had a curious instance of this once; every gun has a spare lock issued with it, and on one occasion we had a gun which went perfectly well with one lock, but would not go with the other, every part of which gauged exactly, and the two assembled locks were the same weight; we took the two locks to pieces, mixed the parts up together in a box, and then re-assembled them; the gun then went perfectly with both locks.

While on this part of the subject, I should like to state that it is my very strong opinion that every officer and N. C. O. who is likely to have charge of a machine gun in the field should go through a short course at Enfield, to gain not only a knowledge of the mechanism of the gun, but also a knowledge of the chief causes of failure or stoppage, and how

such failure can be rectified. We are continually having complaints of the failure of guns, and on examination it is found that the fault is not with the gun, but with the lack of knowledge of those using it.

I will take one instance which is continually happening. The fusee spring is a spiral spring, which brings the gun back into position after firing; the weight of this spring for the .303 should be from 5½ to 7 lbs., that is to say, when all is right and under normal conditions the gun should fire correctly with spring between these weights. If the spring were put lower than this under normal conditions the gun would knock itself to pieces, but several causes may arise which will check the recoil of the gun; sudden and intense cold may reduce the recoil given by the cordite, sand or grit may get into the action, or want of oil may cause too much friction, etc., and in such a case, if there is seen not to be enough recoil, in an emergency the fusee spring should be lowered below the prescribed limits until the gun works. Of course, if time will allow, and the cause is discovered, it should be rectified as soon as possible, and the spring put up to its proper weight.

The Maxim gun is a good gun, but it can hardly be called an ideal automatic gun, and I believe that the evolution of automatic machine guns is still in progress.

I am strongly of opinion that the qualities to be desired in a machine gun are in the following order of merit:

1. *Certainty of Action.*—This I consider immeasurably outweighs in importance every other consideration. If a gun will only go on firing steadily and certainly it is a matter of small importance whether it fires 300 or 600 shots a minute, but it is very certain that it would be far better that it should fire 6000 shots steadily in ten minutes, than the same number in five minutes, and then stop. The ideal gun in this respect should be ready and willing to commence firing, and continue firing with absolute certainty of action for an indefinite period.

2. *Simplicity.*—The first condition must, I think, be to a certain extent dependent on this, for naturally the fewer parts a gun has, the less chance there is of any particular part giving way.

It is most desirable that the parts should be few in number, and these should, if necessary, be quickly and easily replaced, thus doing away with the necessity of mechanical skill; also, fewer spare parts are necessary.

3. *Endurance.*—By this I mean the capability of the various parts of the mechanism to resist wear, and the jar which seems to be necessarily inherent to all automatic machine guns.

4. *Accuracy.*—Extreme accuracy is not absolutely necessary for a machine gun in the field; you don't want to put 20 or 30 bullets through the same man, and an automatic gun with a lateral spread would be rather a good thing. Accuracy of course depends upon the barrel and steadiness of the mounting, and the accuracy of the barrel depends on how long the rifling will stand. The intense heat of the cordite flame has, *ceteris paribus*, shortened the life of the barrel.

Excellent results have been obtained with nickel-steel barrels, and many of them are in the service.

III.—INSPECTION.

I come now to a subject about the details of which little is known by the general public, or even by the services. The duties of the officers engaged in the inspection department require the greatest possible care, and involve great responsibility. So long as everything goes right, little is heard of them, and I fear the services generally hardly appreciate them as they deserve; but should a weapon find its way into the hands of navy or army in which any defect, often an imaginary one, is discovered, it is at once, "Who was the inspector?" "Hang him!" I much wish that officers and others who are interested in the subject would visit Enfield oftener than is the case. We should always be delighted to see them and show them the various tests and trials to which the weapons they are interested in are subjected.

Inspection of arms may be divided into three heads:

1. Inspection of arms during manufacture.
2. Inspection and trial of the finished arms.
3. Inspection in the hands of troops.

Up to the year 1888 manufacture and inspection were under one head; in that year they were divided into two departments. I do not propose to discuss the advisability of this course. The aim and object of the inspection branch remain unchanged—they are to guarantee that good and serviceable weapons are passed into the service, and from periodical inspections to insure that they remain so.

A good inspector of small-arms must, in addition to having a good knowledge of the mechanism and use of the weapons he has to examine, be endowed with a large amount of common sense, for by the aid of this latter most of the questions which he has to decide must be answered.

In the course of manufacture components of any arm are rejected for one of two causes—bad workmanship or bad material. Now the men called viewers, who examine and gauge the work, are necessarily allowed very little discretion, and if any component is manifestly not good enough for issue the viewer rejects it; but if it is very nearly right, but not quite, he has to put it on one side, and it is then for the inspector to decide whether it should be taken or not. His common sense must come into play, and he should put to himself the question, Will this defect seriously interfere with the efficiency or interchange of the weapon or not? If he can answer this in the negative he is generally pretty right in accepting the article in question; if not, the reverse. Though this seems very simple it is not so always, and very often an inspector has some puzzling cases to decide. He should be quite sure he is right, and be able and prepared to defend his decision if it is called in question, which it very often is.

Articles are rejected, as I said before, for one of two reasons:

1. Bad workmanship,
2. Bad material.

In the last 20 years machinery has so vastly improved that there is very little rejection for bad workmanship. Most of the machines are automatic, and when once a machine is set it goes on turning out the same component hour after hour precisely the same, and there is no chance of its getting tired, careless, or making a mistake; wheels and cutters may and do wear, but this is at once discovered and the machine re-adjusted. To give you an idea of the improvement in machinery, I will give one example—"the barrel-boring machine." Up to 14 years ago the machine was a vertical one, the barrel revolved, and the boring-bit was fed down by a handwheel; the barrel was bored first at one end and then at the other. One man had to look after it, and it took 70 minutes to finish a barrel.

Now the drilling machines are horizontal, each machine bores three barrels from each end at once, they are entirely automatic, bore three barrels in 35 minutes, and one man looks after two machines, as all he has to do is to take out the finished barrels, and put in fresh ones. These machines are very accurate, and the barrels require very little setting, which of course is a great thing. Instances like this might be multiplied *ad infinitum*.

The second cause of rejection, "Bad material," is a more serious matter, and it is much more difficult in many places to detect.

Carefully-devised chemical and mechanical tests are, of course, laid down in the specifications, and all that the inspector has to rely on are these, and careful examination under a powerful lens of the texture and appearance of the metal. But from my experience of steel for components of small-arms I have very little faith in chemical and mechanical tests for that material. I am pretty sure that however carefully such tests are applied, cheap indifferent steel can be manipulated so as to stand them, and yet be quite unsuitable for the purpose for which it is intended.

The real test is how the steel behaves in manufacture and after manufacture, how it behaves in the finished arm.

When a private firm makes weapons of any kind for the government they find out by actual trial and experiment what quality of steel is most suitable for each component, both for working and standing the various tests and trials to which the weapon is put when finished; when the private manufacturer finds he has got satisfactory stuff, he will stick to that kind of steel as long as possible, the original cost of it being quite a secondary consideration, as he knows that if his material is not good his finished weapons will be rejected, components will break in the various tests and his loss will be very considerable.

The result of this is that when the components have gone through the prescribed course of inspection, the inspecting officer passes them into the service with confidence, which experience has shown is rarely misplaced.

I have sometimes been inclined to think that in such matters the heads of the government manufacturing establishments are not allowed quite so free a hand as is desirable. They do not make purchase of material themselves, and even if one batch of metal proves entirely satisfactory there is no certainty that the next lot required will be of exactly the same character, or the produce of the same manufacturer, consequently although it may be very good stuff it may require a totally different treatment during manufacture in order to give satisfactory results. I do not think the system of obtaining steel for the purpose in question by open contract (even if tenders are invited from only a few firms) is quite satisfactory. Price may enter too much into consideration; as it may be laid down as an axiom that:—"No steel is cheap. Good steel is necessarily expensive, and bad steel is dear at any price."

Do not misunderstand me; I do not mean to imply that we are not using good steel now; I think all the steel now used in the manufacture of small-arms and machine guns very good and satisfactory. I am only propounding what I consider the right principle on which this satisfactory state of things should be arrived at and maintained, and I think the easiest way to arrive at it is, as I have said, to give the superintendents in charge of government small-arm factories a free hand in the use of suitable steel.

The chief cause of rejection for bad material is the presence of what are known as "greys" on the surface of the metal. A "grey" is a fine black line, or even a speck, and it may be the top or bottom of a hollow in the metal; if possible, when one of these is observed, a fine file is used to see if the grey increases or disappears; this plan, however, is not feasible in the interior of a barrel, and as it is impossible to say how far in the "grey" may go, or how big a hollow there may be in the metal below, it is a hard and fast rule that no barrel should be passed into the service having a visible "grey."

I will give you an instance of a case which happened a few years ago. A particular rifle was passed as the barrel was perfectly clean inside and out; it was finished and made into a rifle, passed the heavy first and second proofs, and was then handed over to the man who was firing for extraction (three service cartridges are fired from every rifle to test this). He fired two shots, and at the third shot the rifle burst and blew his hand off. On examining the burst barrel, I found a large hollow inside the metal, only covered by a thiu skin of metal on the out and inside. Of course if this hollow had come to the surface it would have shown as a "grey," and the barrel would have been rejected. This accident confirmed me in the opinion that as hollows might exist undetected, any barrel which had the slightest suspicion of such a hollow should be rejected.

Before leaving this branch of the subject, I wish to say a few words on the subject of the sighting of rifles, and the various tests applied, as I have been lately continually asked questions about it.

When the pattern of any new rifle is definitely settled, a number of them are fired at different ranges, and from the mean result the sighting of that particular arm is definitely settled. Every kind of rifle has a "throw" peculiar to itself, that is to say, it has a tendency to throw to one side or the other of the point aimed at; this may be due to the system of rifling, the mode of stocking, the whip of the barrel when fired, all or any of these causes. The Martini-Henry threw to the right, and this was compensated for by fixing the back-sight at an angle to the left. The Lee-Metford threw to the left, and in this case it was compensated for by having the barley-corn to the left.

The sighting having been determined on, a standard barrel is very carefully made with this sighting, and from this all the delicate sight-testing machines are made. The sights of the finished barrels are very minutely tested, and it is quite certain that the sights of all rifles of the same pattern are absolutely identical.

When the rifles are finished, 10 per cent. are fired from a machine rest for accuracy at 500 yards. They have to make a pattern having a figure of merit below a certain standard; if any rifle does not pass this, which is very rare, it is sent back to the factory to be overhauled, and, if necessary, re-lapped.

Now it is a curious fact that barrels, though rifled by the same machine, with absolutely identical sights, tested to the $\frac{1}{1000}$th of an inch, will, when made into rifles, not all shoot in the same direction, and some of them may "throw" considerably, either high or low, left or right. If this is noticed when the rifle is fired for accuracy, it is sent back for re-examination and adjustment if necessary; but as it is manifestly impossible to fire every rifle at a target, when as many as 3000 are made in a week, it stands to reason that now and then a rifle may get into the service which "throws" a bit to one side; this of course would be absolutely immaterial on service, but it is a distinct annoyance when shooting at a target at 200 yards, say, to have to aim a foot to one side of the bull's-eye.

In the case of target rifles made by private firms, for private individuals, each rifle is shot at the target, and the sight regulated by hand, until the rifle shoots centrally, but it is manifestly impossible to think of adopting this method for a moment when rifles are turned out by the thousand. It is, however, not quite correct for officers, when reporting this matter, to say the rifle is a bad shooting rifle; a bad shooting rifle is one which does not keep its elevation, or that shoots sometimes to the right and sometimes to the left, in fact, all over the place; but one that shoots invariably a certain distance to the right or left, high or low, merely wants the sights adjusted to make it shoot perfectly straight and well.

INSPECTION OF ARMS IN THE HANDS OF TROOPS.

This was instituted as a regular thing in 1887. Since then the arms of all Regulars in Great Britain and Ireland have been examined every

year—those in the militia once in three years, and volunteer arms were sent to Birmingham periodically for inspection and repair. I shall never forget the state of some of the arms when I first began this examination, some of them were so absolutely dirty that I could not see down the barrel. However, matters soon improved, and the arms in the hands of troops were, on the whole, kept in a very satisfactory condition; but, with the introduction of the small bore and cordite, matters became very bad again, and it was some time before all concerned could be got to understand that arms firing cordite required more and constant cleaning than those firing black powder; such, however, is undoubtedly the case. There is very little dirt or fouling to be seen in the barrel after firing cordite, and what little there is is very easily removed; having done this I have no doubt the British soldier thought all was well, and I have also no doubt many were much surprised on looking down their barrels the next day to find them red with rust.

There have been various reasons given for the formation of this rust. One generally believed in by chemists is that the intense heat of the flame of cordite has such an action on the surface of the barrel as to render it what may be called very sensitive to moisture, and consequent formation of rust. This may be, and is, no doubt, true, but I cannot help thinking there is something more.

The products of the explosion of gunpowder are distinctly alkaline, which of course is a preventive of rust; those of cordite are not only not alkaline, but I cannot help thinking have some action on the barrel which actively induces rust, and I think so for this reason: if you carefully wipe out a barrel after firing cordite, and then leave the inside of the barrel coated with oil, on wiping this oil out with a white rag some hours after you will find it red with rust; now this rust could not have come from the moisture in the air outside, as the surface of the barrel was covered with oil, it must therefore have formed underneath the oil on the surface of the barrel.

However, I am not a chemist, and I may be wrong; it is sufficient for us to know that arms after firing cordite will rust, unless carefully and constantly cleaned.

There is no royal road to it that I know of, but it does not take much time or trouble to wipe the barrel out with the pull-through and rifle oil, as soon as possible after firing, being careful to leave the barrel coated with the rifle oil, which, as you know, has a certain proportion of alkali in it, and repeat this operation as often as possible; as I say, it does not take much time, and the oftener it is done the better. If any rust is found to be forming, the double pull-through will remove it if applied at once. Do not use cleaning rods, or if you do, see that they are made of hard steel. Cleaning rods of wood or soft metal damage the barrel and grooves.

It took some time to convince soldiers of the necessity of this constant cleaning, and for the first few years after the adoption of cordite

the number of arms destroyed from the action of rust was appalling. On examination, all the arms found rusty were sent to Birmingham to have the rust lapped out if possible; now, the bore of the barrel is .303 inch, and after it is enlarged beyond .308 the shooting falls off; in other words, it is only possible to remove 2½-thousandths of metal without destroying the barrel; the consequence was that a very large number of barrels had to be replaced by new ones.

I had an idea that cordite rust would not injure the shooting of a barrel much, and I carried out some experiments, firing a rifle with cordite twice a day for some months, leaving it uncleaned; it was in a terrible state of rust at the end, but shot just as well as the first day.

In consequence of this we have stopped sending barrels with rust in them to Birmingham for repair, unless so bad as to be dangerous. The rust is removed on the spot as far as possible by the armorer-sergeant, and the rifles remain with the regiment. I am glad to say, however, that the inspections of the last two years have been very satisfactory, and every one concerned seems to have got over the difficulty of cleaning. I have also lately examined the arms of many volunteer battalions who have now had the magazine rifle in use for some time, and the very excellent condition in which I found them all not only reflects very great credit on all concerned, but shows that they have found no insuperable difficulty in cleaning their arms after the use of cordite.

There is one more point that I want to draw your attention to. I have said that after the bore of the Lee-Metford or Lee-Enfield exceeds .308 the shooting falls off; this, generally speaking, is the case, but it is not invariably so. If the lands between the grooves alone wear away, the rifling almost disappears and the shooting falls off; but if the lands and grooves wear equally, the bore may be enlarged many thousandths more before the shooting is much damaged,

For this reason I have always been averse to the indiscriminate issue of gauge plugs. If this were done, many perfectly serviceable weapons would be destroyed. The one satisfactory test in this matter is the practical one of firing from a sand-bag rest at the target, the serviceability of the rifle being judged from its performance,

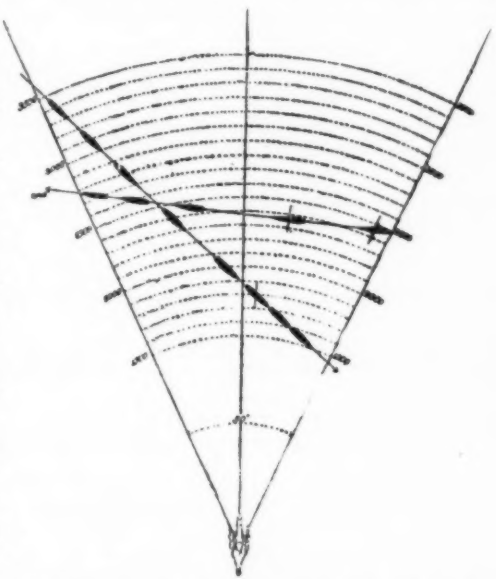
I found on preparing this lecture that the subject was so large as to render it quite impossible to go into as much detail as I could wish without exceeding the limits of a single lecture. I have therefore been obliged to curtail considerably, and pass over many weapons in a somewhat slip-shod way. I have also only noticed those weapons with which I have personally come in contact, either professionally or otherwise. I hope that what I have laid before you has been of interest, and that my venturing to trouble you with my own opinions and experience may be excused. when it is remembered that my position has compelled me during a large portion of my life to give much thought to the subjects dealt with—subjects of paramount importance in connection with the efficiency of the services.

MORRIS' TUBE PRACTICE.

By Lieutenant G. C. STURROCK, R. A.

(*From Proceedings of the Royal Artillery Institution.*)

THE following account of Morris' Tube Practice may be of interest. The company to which I belong, No. 5 Company, S. D. R. A., had not for the past eight years been in a coast-defense station, and therefore the great majority of the men knew comparatively little of coast-defense work. In the early part of 1897 we were told that we should do our practice, including the competitive, at Bombay with 6″ B. L., at coast-defense targets. It was, therefore, necessary to give the N. C. O.'s and layers some idea of the work they would have to do, *i.e.*, duties of gun layers and gun captain. We made many attempts to do this with our armament; 64-pr. converted guns on wooden sliding carriages, taking "ekkas," bullock carts, etc., moving across a bridge of boats about 1000 yards from the fort as laying points, but with a very limited amount of success; the guns and mountings being unsuitable and not fitted for Case II. I was then allowed to work out a system of Morris' tube practice and after some two months the following finally evolved itself.



A flat portion of the parade ground was chosen, with a wall at one end of it; at the other end a 40-pr. fitted with a .220 Morris' tube was placed on a platform. From a point under the trunnions at a scale of 10 ft. to 1″ (R. F. $\frac{1}{120}$) distances of 1500, 1600, etc., up to 3500 yards were marked out straight to the front. A cardboard reader was then fixed to the carriage by the elevating arc on which a long paper strip was fixed. The gun was then laid Case I on the different ranges and the paper strip graduated for every 200 yards up to 2500, and thence for every 500 yards, and from this was filled in by interpolation.

A paper straight-edge sight was fixed on the French's sight of the gun (to allow of sufficient deflection being obtainable). The range strip was checked by several rounds being fired by Case II down the marked straight line in front. Then curves of range (*vide* diagram) were marked out on the ground by trial shots, and these were filled in with chalk. An arc of about 50° was obtained for the fire area. The G. G. C. performed the duties of B. C. and range finder by means of the arcs on the ground. It was found necessary to mount on a limber and use field glasses for observation purposes, although the longest range was under 30 yards. Ranging was carried on in the ordinary way, and was very necessary as the gun, after being traversed two or three times, would run up eight or nine inches (25 yards) and the paper range strip had an awkward habit of shrinking. The latter was got over by putting on a new duplicate strip on the old marks, daily, before firing, but the fitting is rarely so accurate as not to necessitate some slight correction; never, however, more than would be a probable variation of gun range.

The detail required was:

One G. G. C.
One detachment consisting of G. C., G. L., and four other members.
One target man.
Two safety sentries.

The detachment was told off in the ordinary way, their general duties being as follows:

G. C. *vide* G. A. drill.
G. L. " " "
2 and 3 traverses, runs up or back, if required.
4 elevates and fires.
5 attends to tube and loads.

The layer stands on the end of the trail and leans on a handspike fixed in the trail.

The target No. towed the target by means of a long string, taking if necessary a lead round a picket or tent peg. In order to interest the men, the targets used were paper models (fitted on a flat board), usually of torpedo boats, but we also had models of the *Terrible*, a second class Japanese cruiser at present building,

The torpedo boats were very rough models, about six to ten inches long, and were patched up daily with stamp paper. The other models were more highly finished and stood punishment remarkably well. The Japanese cruiser had some 250 hits or more and was still serviceable as a record target when discarded, although only one gun and one mast had survived.

As to accuracy the following speaks for itself:

The target was the *Terrible*, speed twenty knots per hour, range varying from 3500–1500 yards, eight rounds and seven hits (main

length with line of fire 35°), the hits being all within a space of 10″ along the side of the ship (or 100′). All of them were far aft, and a very slight difference in time of firing made a difference of 5″ or 6″ along the side of the ship. The second run on that day was across the front from 2400–2800 yards, five rounds and four hits, one being a ricochet. These were closer together, the first two being 2″ and 3″ aft of the forward mast, and the next two hits with altered deflection being both within 3″ of the bow. The third round was short as when altering the deflection to bring the shot forward the range was not increased proportionately.

PRACTICE AT MODEL OF "TERRIBLE."

The position of the ship is shown at each round on the diagram.

	Range on Gun.	Actual range bow waterline.	Remarks. Deflection 10.
1	3500	3325	Hit. 15 feet up, 80″ from stern, came out on waterline about 20 feet from stern.
2	3300	3025	Over. Looked like a hit from battery.
3	3000	2725	Struck after bridge, then breech of after 9.2″ gun and destroyed latter.
4	2500	2325	Hit. About 12 feet in front of aft 6″ casemate 4 feet up. Ricocheted inside, came out grazing after mast and cutting up through conning tower.
5	2200	2025	Hit. Passed between muzzles of aft 6″ (both trained aft) and out on opposite side about 80′ from stern.
6	2000	1825	Hit. A little further aft on near side and forward on far side. Waterline on far side.
7	1750	1600	Ditto. Waterline on far side.
8	1650	1525	Ditto. Ricocheted inside, came out high up.
			SECOND RUN. Deflection 30 Right.
1	2400	2375	Hit. About 4 feet up aft of forward 6″. Ricocheted up through deck.
2	2400	2400	Ricochet hit about 12 yards short, close by first round.
3	2500	2550	Short about 70 yards, ricocheted over. Changed deflection from 30 R to 20 R.
4	2750	2650	Hit, glancing on deck, ripping deck for about 20 feet.
5	2850	2800	Hit. Entered part of forward 12-pr. disabling and dismounting, came out on waterline.

The best practice made was:

Range between 2400 and 2500 yards.
Target 70′ long (7″).
" 10′ beam (1″).
" 4′ he ght above waterline (4).
Speed about twenty-seven knots.
Main angle with line fire about 90°.
Result seven rounds and five hits.

The easiest target is one approaching or receding directly to or from the gun. The hardest a target with small freeboard and beam, at a constant or very slowly varying range.

A longer range could not be used owing to the smallness of the graduations on the range strip. The speed is very hard to manage. If slower than twenty knots or thereabouts the target sticks and jumps forward forty or fifty yards at a time. The targets were all modelled to scale (R. F. $\frac{1}{120}$) in paper, as accurately as could be done from published dimensions.

One advantage of these targets is that in place of the laying parade being exceedingly uninteresting and tiring it was no uncommon sight to see practically the whole battery watching, and the layers themselves asked permission to have the gun out to practice by themselves at it.

THE ORGANIZATION AND CONTROL OF TRANSPORT IN THE FIELD.

By Captain ASTLEY TERRY, A. S. C., Esquire of St. John of Jerusalem (Commanding Army Service Corps, Guernsey and Alderney District).

(*From Journal of the Royal United Service Institution.*)

IN an interesting paper which appeared in the December number of the Journal of this Institution, Colonel Mark Bell, R. E., claimed—and I think rightly claimed—the title of "The Fourth Arm" for the Royal Engineers.* I am firmly of opinion that the train of an army, with us the Army Service Corps, is of such vital importance in modern warfare as fully to entitle it to be called "The Fifth Arm."

Although this name has suggested itself after the appearance of Colonel Bell's paper, the subject of which it treats is of maturer growth, the outcome, in fact, of some years' study of transport in the field.

It will not, I think, be denied that the difficulties of supply and trans-

* "The Fourth Arm." By Colonel Mark S. Bell, V.C., C.B., R.E., A.D.C., *p.s.c.* (Commanding Royal Engineer, Western District) Fe low Kings College, London.

port in war have increased enormously in recent times; that is to say, the amount of *impedimenta* essential to the efficiency of an army is proportionally much greater than it used to be. This fact, it seems to me, may be attributed to two main causes:—

1. To the growth of science as applied to the art of war, which has not only replaced the rude weapons of our forefathers by others of complicated and delicate mechanism, but has so altered the methods of fighting as to render a modern campaign a far greater strain on the human machine than in the days when a stout heart and a strong arm were the only qualifications required of a soldier.

2. To the spread of civilization, which has reduced war to a great game in which certain fixed rules must not be violated, and which forbids armies to lay waste a country in which the inhabitants offer no resistance.* Our armies can no longer live from hand to mouth at the expense of a defenseless population. We can use the resources of a country, we can by purchase and by requisition take anything which is not absolutely indispensable for the immediate requirements of the inhabitants; but we may no longer treat the individual as an enemy to whom no mercy is to be shown merely because we happen to be fighting against his fellow-countrymen.

Much more is now demanded of the soldier than formerly; if not in actual bravery, at least in those qualities which make even a greater demand on his moral and physical condition. Therefore he must be well cared for and well fed, must be provided with hundreds of articles necessary to keep him efficient, must be nursed when sick, and must be treated, in fact, in a manner which to his predecessor of a couple of hundred years ago would have appeared positively luxurious.

I am speaking, of course, only of war as waged between civilized nations; and it will be convenient to state here the limits within which I propose to confine myself in this paper.

To begin with then, I am only going to consider the case of war with another great power, in which the work of the Army Service Corps will necessarily be entirely different from what it is in our numerous "little wars," waged for the most part against savage foes, in trying climates, and necessitating special organization to cope with special conditions. These "little wars" are of such frequent occurrence that a large number of the officers of the Army Service Corps have served in one or another of them, and it would be presumption on my part to attempt to theorize on a subject of which from practical experience, others are so far better qualified to speak than I. The knowledge gained by the individual in such campaigns is of the utmost value; but the Army Service Corps as a body is not employed, and the subject therefore does not fall within the limits I have here set myself.

When we consider the case of a big war, however, matters are alto-

* Except in a friendly country when it is absolutely necesssary to prevent the enemy obtaining supplies as was the case before the Lines of Torres Vedras.

gether different. Colonel Furse * says:—"The system of victualling entirely from the base, the only possible one in our small wars, is no school for the large supply operations of European warfare." We have not fought a European power since the Crimea, and I fear the lessons to be learnt from a study of that campaign are of a negative character. We must go back then to Peninsular and Waterloo days for examples of the work of the train in war; but those days are long past, changes almost revolutionary in their character have taken place since; and consequently we find ourselves, to all intents and purposes, in the dark as to the course to be followed in the future. It is true that we can derive much valuable information from studying the campaigns of other countries, notably that of 1870–71. But apart from the fact that the war between France and Germany is fast becoming ancient history, we have to remember that our transport and supply organization necessarily differs from the German in several particulars. Hence, we must base our methods to a great extent on theory, and endeavor by constant study to arrive at the truth.

In the second place, I am not now concerned with the various kinds of transport which fall outside of the control of the Army Service Corps proper. I mean transport by railway, by river, by canal, or by sea. The consideration of these would take far too long to be adequately discussed in the time at my disposal this afternoon.

Again, transport in the field may roughly be divided into two parts, usually known for the sake of convenience as First Line and Second Line. The work of the latter is carried on well in rear of the army, safe from any attack by the enemy, and in great part at least by civilians under proper supervision. This again falls outside the scope of my paper.

It is the first line of transport, then, that I call the "Fifth Arm," and it is of this part only that I propose to speak this afternoon.

There is happily no need to insist on the fifth arm being entirely a military body; the necessity for this is now universally admitted for the following reasons, viz.:—

1. Strict discipline is absolutely necessary, and cannot be properly maintained among civilians.

2. The commander of an army must have the same absolute control over the transport as he has over the other arms.

3. A sudden panic is less likely to occur, and if it should, it can be more easily checked.

But to my mind there is a more important point still, and I cannot do better than again quote Colonel Furse. He says:—"A military transport has the further advantage of securing a reserve of trained men in the hour of need (with us a point of considerable importance). Here we have in place of a source of weakness an accession of strength which often we cannot otherwise easily procure. In place of having to guard

* "Military Transport." By Lieut.-Col. George Armand Furse, D.A.Q.M.G.

and protect a host of helpless followers, if we can secure nothing else but their own defense and that of the animals and material under their charge, dispensing with numerous guards which can be more effectively employed elsewhere, and which our small armies can spare with great difficulty, something will be gained."

This brings me at once to a question of the first importance, viz.:—Is the Army Service Corps as at present constituted capable of self-defense?

To find the answer to this question it is only necessary to take up the mobilization tables,* and look at the strength of a company on service,† or rather at the proportion of men to horses. It becomes at once apparrent that the number of spare men ‡ is quite inadequate to defend those employed as drivers, who cannot possibly be taken away from their animals to assist in repelling an attack. Moreover, it must be remembered that all the men shown as privates are butchers, bakers, or clerks, who will of course be required for their own special duties, and who cannot be employed as fighting men, because, firstly, they are widely distributed, and, secondly, because casualties amongst them would speedily reduce their numbers below the minimum required, and so seriously cripple the resources of the army. We must therefore take the numbers of the transport men only. The 1st Army Corps requires 16 companies, which give a total of 1922 drivers, and 3270 draught horses. If we allow one driver to every two animals (a low estimate, because there are a certain number of one-horse vehicles and pack animals) we find there are just 287 spare men. Again, for a certain line of communications there are 5 companies allotted,§ which give a total of 615 drivers and 1000 horses; that is, 115 spare men. So that altogether 21 companies on a war footing only produce in round numbers some 400 spare men, an average of 19 men per company; or put in another way, the proportion of spare men to the total strength of a company is on an average about one in six. On a peace footing the proportion is about two in three, which is better; and yet, as every officer commanding a company knows, the number of spare men allowed barely suffices to carry on the ordinary routine duties in barracks! We may safely assume therefore that the 19 spare men per company is the minimum number that will be required in war for carrying out the necessary duties, and that they will not be available for fighting. It does not matter how many companies or parts of companies may be united in any one convoy,‖ the relative proportion of spare men to drivers will remain practically unaltered.

But, it may be asked, is it necessary or even advisable that the

* See "Manual for Field Service, Army Service Corps."

† It will be noticed that the companies vary in strength according to the nature of their duties.

‡ All the transport men of an Army Service Corps company are trained as drivers. I use the term "spare men" to denote those who are not in charge of animals.

§ Exclusive of one depot company.

‖ I use the term "convoy" not in its usually restricted sense, but to express any portion of the first line of transport.

Army Service Corps should be able to defend itself; and if so, to what extent? Would it not be better to entrust its defense entirely to the other arms? At present, if peace manœuvres are any guide, the last question will have to be answered in the affirmative; but this, I take it, is because the companies are not strong enough to conduct their own defense.* As a general rule the attack and defense of convoys is but little practiced, presumably because it is considered that the other arms can be more profitably employed; and hence the fact that in nine cases out of ten—I speak so far as my own experience goes—the Army Service Corps is declared neutral, and therefore derives no benefit from the tactical lessons of the manœuvres. Another reason for this is doubtless the increased comfort conferred on the troops generally by their supplies reaching camp in good time without let or hindrance.

I submit that all this is a great mistake, because it is not what would happen in war when in contact with the enemy. Our system, during manœuvres, of operating from standing camps must bear the chief blame, though this, no doubt, is owing to the necessity for cutting down expenses; and, moreover, the peace strength of the Army Service Corps is so small that unless the plan of standing camps be adhered to the number of troops engaged would have to be considerably reduced. The truth of the matter is, that on peace manœuvres the Army Service Corps is not employed as the train of an army in the field, but that all its energies are devoted to keeping the troops supplied with the actual necessaries they require, quite irrespective of tactical considerations. It will scarcely, I think, be maintained that this is the best possible training for war.

Peace manœuvres, then, cannot be considered a safe guide; as a matter of fact there are weighty reasons why the Army Service Corps should be numerically strong enough to undertake its own defense. They are:—

1. The commander of an army will not have to make elaborate arrangements for the safety of his supplies, and will thereby be saved much trouble and anxiety. It is true that his lines of communication will still require troops of the other arms for their defense, but the numbers of such troops will be capable of considerable reduction.

2. No men need be taken from the fighting line to march with the baggage and supply columns, and consequently the efficiency of the army will be considerably increased.

3. The escorts being composed of drivers will be far more useful than infantry soldiers possessing no knowledge of horses; and the convoys will be homogeneous, which in it itself is a great advantage.

Now, to what extent should transport of the first line be capable of self-defense? As I understand the matter, the troops told off to protect a convoy will be divided into two bodies. One, the most numerous, composed of infantry, cavalry, and as a rule, artillery (a miniature army) will

* There are 34 drivers and 13 pairs of animals in a transport company on a peace footing.

manœuvre at some distance—two or three miles, probably—from the convoy; and will form in fact a covering screen, through which the enemy should not be able to penetrate. This body, for want of a better name, I call the convoy "guard. The second body, which I call the convoy "escort," will march with the convoy, and will consist chiefly of infantry, with a small party of cavalry as scouts. The escort should be capable of beating off any parties of the enemy that may elude the guard; and, as we have seen, should consist entirely of men of the Army Service Corps. Wherever in the course of this paper I speak of the defense of a convoy, it must be understood that I refer only to the convoy escort, and not to the convoy guard; for with the latter the fifth arm has really nothing to do.

We have now arrived at two definite conclusions:—

1. That convoys in war cannot, (as the Army Service Corps is at present constituted) defend themselves.

2. That within certain limits they ought to be able to do so.

The further question at once arises: How is this desirable result to be brought about?

Three main conditions must be satisfied, viz.:—

1. The number of spare, *i. e.*, fighting men, must be sufficient.
2. These men must be at least as well armed as the enemy; and
3. They must be properly trained in peace.

To determine the numbers required to carry out a certain fixed undertaking is by no means easy; but when the conditions are ever-varying, as in the present case, the difficulty of arriving at a positive conclusion is enormously increased. Peace manœuvres, as we have seen, are no safe guide: examples taken from actual warfare are not much better, because the strength of the escort must necessarily vary according to the nature of the country and the proximity, strength, and character of the enemy. It is not to be expected that England will maintain in peace, even including reservists, the maximum number of spare men which military history tells us has been, and so may be again, required to protect a convoy. Therefore the escort must, in special cases, be augmented by the other arms. But, on the other hand, the nation may reasonably be asked to furnish more than the bare minimum; in order that, as a general rule, the numbers may be adequate without additional aid.

I suggest that, as a tentative measure, the proportion of men to draught horses in a transport company on a peace footing be fixed at two to one. This would necessitate adding 18 men to each company, that is a total of 612 additional men to the corps.* Not a very extravagant demand surely, now that the army is being increased, and it is remembered how weak the corps is at present even for its duties in peace. "The conduct of convoys, and the formations to assume in case of attack, require to be carefully understood by all officers"; so Colonel

* There are 34 service transport companies.

Furse; and unless each company is brought up to at least the strength I have suggested, it will be impossible to practice in peace the duties which will be required in war. The number of officers too must be considerably augmented. Colonel Ward * says: The estimate of establishment [for a line of communication] now given is calculated on a very liberal scale, and will, as a rule, on account of the scarcity of officers, be considerably reduced. That is to say, our organization for war exists on paper only, or can only be maintained by drawing from other branches of the service officers who can have had little, if any, previous training in transport duties; and at a time, too, when their regiments can least spare them. There is another strong argument in favor of increasing the number of men in a company on a peace footing. It is that the present peace establishment is so small compared with the war establishment, that on mobilization a company would be literally "swamped" with reservists—strangers to their officers and to each other; and this at the very time cohesion and mutual confidence would be most needed.

The proportion of two men to a horse would, on a war footing, be in excess of normal requirements, and might, therefore, I think, be reduced to one man to a horse. This would give the 21 companies required for the 1st Army Corps and line of communication 4270 drivers instead of only 2537, the present establishment. Of these, 2135 would be spare men, an average of about 100 per company; allowing, that is, one driver to every pair of animals.† This is a large increase, it is true, but surely not too large when we remember that our 21 companies would in column of route extend at least nine miles! Of course, so long a convoy on a single road would be highly improbable; but in any case the proportion of fighting men to drivers would remain constant. A company would, roughly speaking, occupy from 500 to 1000 yards on the march; and surely something under 100 men, a single company of infantry in fact, cannot be considered an unnecessarily strong escort, especially when allowance is made for casualties.‡

I assume, of course, that the number of non-commissioned officers would be increased in due proportion—I consider the present establishment proportionally too small—so that there would be sufficient for scouting, and no cavalry would be needed. Hence, under ordinary circumstances, the train would be perfectly capable of looking after itself; and any possible jealousy between it and the other arms would be avoided.

We will suppose, then, that our transport has got the men required

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* "Army Service Corps Duties." By Lieut.-Colonel E. W. D. Ward, C B., D.A.A.G. Home District.

† As I have already stated, this is a low estimate; besides, many of the spare men would certainly be required for other duties. Probably, therefore, the number actually available would not exceed 70, if so many.

‡ I have purposely omitted all reference to artificers and batmen, because they would be available for fighting if required.

for its defense; and the next point to be considered is obviously how these men are to be armed, and how trained. At present the dismounted or supply men of the Army Service Corps are armed with carbine and sword-bayonet, the mounted or transport men with the carbine only. The fact that they are armed at all points to the supposition that they may, under certain conditions, be called upon to fight; and surely it is our duty to see that they shall be at least as well armed as any enemy whom they may be likely to encounter. This is not the case, however: other things being equal a man with a carbine is at the mercy of a man with a rifle, because the latter can keep out of the effective range of the former, on whom he can fire with impunity. More, once the enemy gets to close quarters, the transport man is at his mercy, having no weapon to oppose to the bayonet except the butt-end of his carbine. I do not seek to belittle the carbine, it is an excellent weapon in its way; but no matter how straight it may shoot up to a given distance, it is valueless if its range be insufficient to reach the enemy. Clearly, therefore, the men of the Army Service Corps should be armed with rifle and bayonet. At first sight it may appear somewhat incongruous to arm mounted men with rifles, but this is not really so; it is simply a matter of custom. Moreover, we must recollect that the transport men of the corps are not "mounted" in the ordinary sense of the word. Certainly the drivers ride their animals, but the spare men sit on the wagons. The present short "knife" bayonet would not interfere with a man on horseback in the least; and undoubtedly it is equally important for the transport man to be able to defend himself at close quarters, as it is for the supply man to be able to do so. At present the drivers are supposed to carry their carbines slung across the shoulder. I say "supposed," because the carbine in this position is very uncomfortable, especially when moving at the trot; and consequently except when marching to attention, the drivers invariably hand their weapons to the men on the wagons. These last carry the carbine in an upright position between the knees, in which manner a rifle could be held with equal facility. We see therefore that the only difficulty in substituting the rifle for the carbine would be to decide on how the former should be carried by the men in charge of animals. To sling it over the shoulder would be inadvisable for the reasons just given, and a bucket would be in the way. Personally I should like to see the mounted men's rifles carried under the floating raves of the wagons to which their horses are harnessed, one on each side. I cannot conceive any possible occasion in which a driver could want his rifle on the instant; in fact, I rather doubt his requiring it at all, his duty in case of an attack being to take care of his animals. In any case the fire of a mounted man is never very effective. As the escort of a convoy must act as infantry, the spare men would have to march on foot; indeed, there would be no room for the great majority of them on the wagons. The present "knee" boot would therefore have to go; and as it is most desirable that the drivers and

the escort should be interchangeable, I would give all ranks a field-boot, which personally I have always found equally comfortable for walking or riding, besides possessing the additional merit of being easy to take off and put on. I have known men sleep in their wet "knee" boots rather than face the painful struggle in the morning of having to get into them again. Spurs would be treated in the same way as leg-guards are now, *i.e.*, only worn when on horseback.

I will touch very briefly on the question of training. The men should be taught the bayonet exercise, and should be put through the same annual course of musketry (with perhaps certain modifications) as the infantry. This could easily be done, as the number of spare men in a company being increased by eighteen would enable the course to be fired by half-companies without interrupting the ordinary transport duties. Skirmishing should be practised, and great attention paid to fire discipline. The magazine rifle would be an unnecessarily complicated weapon to put into the hands of three-years' men with a great deal to learn in that short time; I should prefer the Metford-Martini rifle and the Dum-Dum bullet. I am not aware that such a weapon has yet been made, but it could be very easily and cheaply called into existence. I should also like to see a couple of machine guns attached to each company. They would always be useful, especially to stop a sudden rush, or to defend the corners of a laager.

There is one thing more needed to make the train thoroughly efficient, and that is facility for signalling. A few signallers disposed along a convoy on the march will be found extremely useful, and will save much wear and tear of horseflesh. Even with our small convoys on peace manœuvres I have experienced the want of a few signallers; in the case of a big convoy and an active enemy their value would be largely increased. Silence on the line of march is often essential. Colonel Furse says: "In all cases where noise may point out to the enemy the whereabouts of a convoy, silence should be enjoined, and the drivers should be forbidden to sing, shout, or even to crack their whips." Yet this is the very time when communication between the head and tail of the column will be most needed, and horsemen trotting backwards and forwards are certainly not conducive to silence, while bugle calls will be out of the question. Cyclists will be useful, but their presence will not make up for the absence of signallers. Sometimes, too, a small party of the Royal Engineers will be required to mend roads or repair bridges, and even occasionally to superintend the construction of hasty field defenses.

We have now to consider the command of convoys in war. In the case of a convoy being entirely composed—as we have seen it ought to be composed—of the Army Service Corps, no question of command will arise, for it would be assumed by the senior officer present as a matter of course. But suppose, as at present would be the case, that the escort consists of troops of the other arms; what then? The senior officer, of

course, to whatever branch of the service he may belong, will doubtless be the reply. Certainly; but that is not the point. The question is, Should the senior officer be the officer commanding the Army Service Corps—the officer, that is, who is responsible for the safety and well-being of the convoy—or should he belong to the fighting portion of the mixed force, to whom the defense of the convoy is entrusted? Colonel Furse says: "The officer commanding the escort and convoy should be one; any officers marching with it, though of superior rank, should have no authority to interfere with his command." In other words, the officer commanding the convoy should command the escort also, for it is not to be supposed that the senior transport officer is to be superseded by an officer of another arm, who would necessarily lack the requisite knowledge and experience of transport matters. Nor can there be any doubt but that Colonel Furse is right. The escort is part of the convoy, not the convoy part of the escort; the convenience of the escort, the pace at which it moves, the direction it follows, and the situation and duration of halts,—all are subordinate to the movements of the convoy. The escort is there to fight if necessary, but it must avoid an engagement if it possibly can. The active-defensive may, it is true, be employed when an action is absolutely unavoidable, both to remove the fighting from the immediate vicinity of the convoy, as well as to avoid the feeling of inferiority which a merely passive defense would engender among the troops engaged. The officer commanding the convoy may, if he choose, when it comes to a fight, entrust the actual defense to the officer commanding the escort; but there must be no question as to the right of the former to control the formation and regulate the movements of the whole. There is always the danger of the officer commanding the escort, if he be given free scope, forgetting his true rôle, and seeking to subordinate the requirements of the convoy to the more brilliant but extremely dangerous achievement of fighting a miniature battle on his own account. It is painful to reflect that peace manœuvres are again at fault in this important matter; whenever I have found myself in charge of a convoy, large or small, the officer commanding the escort has invariably been my senior; and no doubt others can tell the same tale. It cannot be too strongly urged that unless we practice in peace what we shall have to do in war, disaster will follow. Why we do not invariably do so is a mystery to me, because the organization of the Army Service Corps points unmistakably to the exercise of military commands by its officers. The corps was changed from a department to a regiment because the former organization worked unsatisfactorily; the officers have precisely the same examinations to pass for promotion as their brethren of the line;* majors are examined in tactics before being promoted to lieutenant-colonelcies; in fact, the intention of the military authorities is plainly that, in the general efficiency of its officers, the Army Service Corps shall be on a level with the other combatant branches of the service.

* Besides having to qualify in their own special subjects.

The two chief objections to my suggestions for a self-protected train will be, I expect:—

1. Increased expense.

2. An increase of non-fighting troops with an army in the field.

With regard to the first of these objections, I have shown that my suggestions, if carried out, need only add some 600 men to the peace establishment of the Army Service Corps—not a very serious burden surely, in view of the great advantages claimed for the scheme. As to the second objection, the spare men of the train would only be non-fighting in the same way as an escort of the other arms would be; and as they would set free at least as many men as they themselves number, it is difficult to see how the objection can be sustained. If the commander of a body of troops in the field—be it an army corps or be it a brigade—were asked which he would rather have, a train which could protect itself, or one which would require an escort of the other arms to insure its safety, I do not believe he would hesitate to choose the former; and if I am right in my belief there is no need to argue the matter further.

What will probably strike most people when considering the subject of transport in the field, is the exceedingly complex state of our existing organization. What with regimental transport, supply columns, bearer companies, bakery columns, field hospitals, and transport for the staffs of the various units; not to mention the further subdivision of the first line into what is always necessary, and what is occasionally required; it appears as if we were almost inviting disorder and consequent disaster. The confusion in rear of a battle-field is necessarily great whether the battle has been lost or won, and therefore we must endeavor by every means in our power, not to add to this confusion more than we can possibly help. At present, the officer commanding an Army Service Corps company would see his company split up from the moment he joined the field army, and half his men and horses he probably would not see from the beginning of a campaign to the end. From no point of view can this be considered satisfactory; but at the same time it is most difficult to suggest other arrangements. The absolute necessity of the supply and transport "services" being under one control is now universally acknowledged; but while fully admitting the overwhelming advantages of such an organization, it must be owned that from a purely transport point of view, it does not tend to simplify matters. But if the Army Service Corps could transfer to other shoulders the burden of transport duties outside its own particular sphere, so as to have to deal exclusively with supplies, that would indeed be a step in the right direction. Colonel Furse remarks: "In advocating that the transport of an army should form a branch of the commissariat, we must make an exception with regard to regimental and medical transport." The former, as we know, is kept distinct, though it, as Colonel Ward well remarks, "when not required for work with the unit, will always be available for general

transport duty." But the latter is at present provided by the Army Service Corps; yet, to again quote Colonel Furse, "the importance of a separate transport for this department cannot be over-rated." The transport duties of the Army Medical Staff differ quite as much from those of the Army Service Corps, as do the latter from those of the Royal Artillery and Royal Engineers, who have their own transport.

It is not my present intention to discuss the question as to whether the Geneva cross will or will not protect officers and men of the Army Service Corps employed with the medical department on the battle-field. The matter was not very long ago argued in the columns of the daily papers, without however resulting in any positive conclusion being arrived at. Certainly the question should be settled definitely once and for all, not merely by the expression of an opinion on the part of the government of this country, but by the unanimous decision of the other powers. The results of uncertainty in a big war could not be otherwise than deplorable.

Personally I should like to see the question settled so far as England is concerned in another way, a way which would at the same time greatly simplify the duties of the Army Service Corps, and that is by training a proportion of non-commissioned officers and men of the Medical Staff Corps in transport duties, in the same manner as infantry transport is trained, by attaching them for a given period to the Army Service Corps. Then on the outbreak of war the medical department would draw the necessary equipment from mobilization stores, and obtain its horses either from Army Service Corps companies not immediately required for the field, or from the same sources as the Army Service Corps draws upon for its reserve animals; and thus would be enabled to carry out its own transport duties unhampered by any possible jealousy or misunderstanding, which might otherwise arise through two branches of the service having a finger in the same pie. This plan would have the advantage of costing the country little or nothing, and would confine the duties of the Army Service Corps within their true limits—the transport of food and supplies.

The fifth arm must not fall into the fatal error of over-estimating its own importance. It exists merely as a means to an end. It must not seek to dominate the operations of a campaign, but rather endeavor to facilitate them by every means in its power. Nevertheless, as it cannot perform impossibilities, it will frequently influence the strategy of a campaign to a greater or lesser extent.

It may be objected, perhaps, that I have taken a too militant view of the duties of the Army Service Corps, and that in claiming for the fifth arm a share in the manœuvres of the battle-field, if not in the actual fighting, I have lost sight of those humbler but more useful duties—the collection and distribution of supplies—to the acknowledged necessity for which the corps owes its existence. Nevertheless I am convinced that in spite of old prejudices which die hard, and in spite of a little not

unnatural jealousy in some quarters, the principles upon which I have insisted will in the end prevail.

It is not the duty of the fifth arm to fight, but it must be strong enough to protect itself, and it will then be far better able to carry out its special duties without interference from the enemy.

My suggestions, though drastic, will, I think, be found to follow one another in logical sequence. If it be advisable—and who can doubt it?—that as many men as possible should be in the fighting line, it follows that as few as possible should be employed in any other capacity, on the line of communications or elsewhere. Therefore within the limits I have suggested the train of the army should be able to take care of itself; and to effect this it must be sufficiently numerous and properly equipped.

To sum up. It has been advocated that the Army Service Corps companies should be raised to such a strength as to render an escort of the other arms unnecessary under normal conditions; that the fact of the train being strong enough to resist if attacked will simplify the arrangements necessary for its safety; that a relatively larger number of men can be placed in the fighting line; that the men of the Army Service Corps should be armed with the rifle instead of with the carbine, and that greater attention should be paid to their musketry instruction; that in the event of an escort of the other arms being required, the officer commanding the convoy should command the whole, and that to this end Army Service Corps officers should be exercised in such commands on peace manœuvres. And, lastly, that the transport service should be simplified by giving the medical department its own transport in time of war.

Let it be remembered that an effective train cannot be created on the spur of the moment; and that, to quote Major Burn,* "On the efficiency or otherwise of the transport depends the efficiency and mobility of the army."

Colonel H. S. B. REEVES, C. B. (retired pay, late A. S. Corps): The lecture we have just had the pleasure of listening to by Captain Terry is headed "The Organization and Control of Transport in the Field," which is a very large subject. The consideration of such a question of "Transport" covers an enormous field, and the conditions vary in different armies and countries, particularly in an army like ours which serves all over the world. But I think in substance Captain Terry has narrowed it down really to a lecture on the transport section of the Army Service Corps and its duties. Captain Terry's main contention is, I take it to be, that the corps should be more independent and self-supporting, in that it should be able to defend itself under normal conditions against an attack. With regard to that, I think that we must realize that it is impossible to lay down any fixed conditions of that sort. It would all depend on the strength of the attack and on the circumstances. It seems to me that the defense of the convoy and its train is one of the most serious responsibilities and cares which any general in the field can have. It is essentially a military and a fighting piece of work. The *raison d'être* of the Army Service

* "Notes on Transport and on Camel Corps." By Major D. B. Burn, 18th Hussars.

Corps, formerly the commissariat and transport, surely is to feed the army, and to provide it with transport, and under our present regulations a general in command of any body of troops is actually charged with the responsibility of that work himself in a very much greater degree than he is with regard to details of other services under his command. At all events, the responsibility rests on him, aided by a suitable and selected staff. It seems to me, therefore, that to lay down any rule which would hamper a general, or any officer commanding a smaller body of troops, would deprive him of a free hand, and that such conditions would be very undesirable. Captain Terry passed over lightly the smaller wars in which we have been engaged and for which our army exists to a very large extent. He, I think, falls into a slight error in saying that the Army Service Corps as a body is not employed in those small wars. No doubt it is not often employed in the form in which we see it regimentally embodied about the streets of London or Aldershot. It depends, of course, upon the construction you put upon the words Army Service Corps. It means more than the name of a corps; it is a branch of the service. We may say that the Royal Engineers do this, and the Royal Engineers do that, but we do not mean necessarily that so many companies of sappers are employed. In the same way transport work has been carried out efficiently by the Army Service Corps in South Africa and in Egypt. Certain companies or units of the corps have gone out with their officers, warrant officers, non-commissioned officers, and a certain number of men, and have formed the nucleus for the formation of transport locally best adapted to the conditions of the country in which they had to work. I should not like the impression to get about that the Army Service Corps as a body can only work abroad in the form under which we see it at home. The question of the Army Service Corps being a military body is a foregone conclusion; it is the result of experience in war that it must be a military body to be efficient and economical. I cordially concur in the reasons which Captain Terry gave for that. With regard to their having to guard and protect their own convoys, I think all we have a right to expect is that they should be able to find their own guards. They are highly skilled men and well paid men. It is not their primary duty to fight; their primary duty is to look after their horses and to work very laboriously, according to their various duties; but of course every soldier in such situations should be armed in the field in order that he may be able to take part in the defense of his camp, and be of use in a general defense of places attacked. There are many instances of men having done that in South Africa and elsewhere. If not armed, a transport soldier is at the mercy of the first man who comes with a pitchfork or shovel against him. The chief thing which Captain Terry advocates is the increase of the men of the corps. With regard to that, he advocates our going as far as having two men per horse on a peace establishment, and I think to take the field with that establishment. Well, I have been a director of transport on service, and I should be very glad indeed to have that number of trained men at my disposal; I should feel very comfortable to be able to expand my corps by having such a large number of men; but I do not see how he proposes to employ those men usefully in times of peace. I think he must remember that the Army Service Corps transport companies we see are raised primarily for war. We could get the work done a great deal cheaper probably at home during peace by employing civilian transport, but it is very necessary for military purposes to keep these men up as a disciplined body of soldiers,

and therefore their services are utilized in times of peace; but how does Captain Terry propose to utilize such a large number of men? To have two men to every horse would be too much, and rather more than the country could be expected to pay for, I think. Complaints have often been made, as I remember before I retired, and it is probably the same now - as to the want of "spare" men in a company at home. I have every sympathy with this feeling. I know the time when I had the same feelings myself with regard to finding so many, what we call "regimental casualties," for duty outside my company, but these disappear to a great extent. When a company is mobilized for war a very far larger proportion of men are put into it. With regard to defending the convoy, I think a general officer must protect his own convoy in the same way as he protects his field batteries of artillery. He would be required to protect his Royal Engineers. He must also protect his ammunition columns. He must also protect his hospitals. The same grounds which Captain Terry mentions for increasing the Army Service Corps to such an extent would apply—well, to the other arms I have just mentioned. He admits that the escort must in special cases be augmented by the other arms. That is rather giving away the system, because if you have all these men with the corps normally, it is admitted that you require more men under certain circumstances, and it seems to me more desirable to let it be a recognized part of the duty of the fighting troops to make such disposition as the general may order for the protection of the train of the army. I only want to add one little word with regard to the reservists. Captain Terry says: "There is another very strong argument in favor of increasing the number of men in a company on a peace footing. It is that the present peace establishment is so small compared with the war establishment that on mobilization a company would be literally swamped with reservists—strangers to their officers and to each other; and this at the very time cohesion and mutual confidence would be most needed." Well, we have heard a great deal of that subject lately in discussions in the press, and that applies to a very great extent to every arm of the service. I agree as to insufficient peace establishment for such large expansion in war, but I should like to say that my own experience is that the reservists called out from the Army Service Corps are the most useful men I have ever had to do with when I have been on service. In 1882, in the Egyptian campaign, we had large numbers of them, and they were the most reliable men we had, thoroughly useful men, perhaps all the better for having been in civil life, where many of them had been hungry and had to work very hard. They quite appreciated coming back to their own corps and comrades, and they were among the best of the rank and file of each company. If one or two things I have said are adverse to Captain Terry's contention, he will yet, I hope, accept my congratulations on having brought this subject before us. I think it is most satisfactory that we have now in the Army Service Corps a body of officers with men like Captain Terry, young active officers, who take an interest in these questions, and bring them up for discussion. These matters are really very important, and cannot be too freely discussed, and I think that we owe him thanks for having brought the question before us.

Lieutenant-General Lord METHUEN, K. C. V. O., C. B., C. M. G.: I wish to make very few remarks, and more so because of the valuable statements from Colonel Reeves, which were those I should have made myself. It was rather a surprise that the lecturer had not thought of that very remarkable anomaly that

we have to find escorts for the artillery and engineers, just as we have for the Army Service Corps; and although no general likes having to detail escorts, I am perfectly certain if I were in command of an army corps I would a thousand times rather find my own officers and escorts for all these duties than leave them to the different officers in command. Again, it would be extremely hard work to expect the same men to escort transports every single day of the campaign, for there is no harder work. There are places like Africa and India, where the conditions are absolutely different. What number of men, for instance, in a transport in India would he require to act for a transport occupying fourteen or sixteen hours of marching on a hilly pass? I may be wrong. With regard to the Reserves, I go absolutely with Colonel Reeves. More willing men I never wish to meet. Lastly, I should stultify myself in any remarks I have to make in a future lecture if I agreed with him regarding the carbine. I am one of those who, on the contrary, are inclined on some grounds to run the carbine against the rifle. The carbine shoots for practical purposes as well as the rifle, it is 2 lbs. lighter, and much easier to carry, and I undertake to say that a man with a carbine and a long bayonet will certainly hold his own against a man with a rifle and a shorter bayonet.

Captain T. W. HEATH (Supply Officer of the North London Volunteer Brigade): The lecturer has not exactly pointed out whether he is dealing with the army abroad or in England. The conditions are totally different. The defense and attack of a convoy in an enclosed country like England, where you cannot advance like you can abroad, where there are no hedges to prevent you, is very much more easy from the great amount of cover available in this country. I should like to have heard the lecturer say something of how he would deal with these matters in England, especially from the volunteer point of view as being the service I am mostly interested in. I am desirous of some information on that point. Still the general information we get in this paper, which I shall read again, is very serviceable. There is one point I should like to refer to. Lord Methuen rather took the wind out of my sail a little, about the rifle. I do not think any man armed with a carbine is at any disadvantage with a man who is armed with a magazine Lee-Metford, simply because in the last few years the chamber of the carbine has been made the same as the Lee-Metford, and therefore it carries the same ammunition and has practically the same range. The muzzle velocity is about 2000 feet per second, and is the same—

Lord METHUEN: I think the muzzle velocity is 100 feet less.

Captain HEATH: It depends on the erosion inside of the barrel. It may be a little less, I do not mean within 100 feet. Still the short rifle loses accuracy after 800 yards, compared with the long rifle. I quite agree with his lordship in the handiness of the carbine to the man defending himself. A man can turn a short weapon round quicker than he can a long one; it is handier, easier carried, lighter, and he fires the same cartridge and therefore can inflict the same wound. I think a man armed with a carbine, especially in enclosed countries, is not at a disadvantage with one armed with the long rifle, especially in a country like England, where the long range of the rifle would not always be available, as one would be so much under cover, and there would be the enclosed roads and valleys where we should to some extent be hidden from view. It is a most interesting lecture, and from the Volunteer point of view I feel very thankful for it, and I personally have to thank the lecturer.

THE CHAIRMAN (Colonel Lonsdale Hale):—I should like to offer with regard

to the lecture a few remarks from the tactical point of view. I doubt the wisdom of dividing the protecting troops into two bodies—the escort and the guard—and also of placing the command of the protecting troops in the hands of two officers, instead of in the hands of one officer. Then Captain Terry would provide for his guard by giving so many men per company. Thus the guard depends on the number of companies required for the technical working of the convoy, and although the commander may foresee that, owing to the difficulties of the road, the convoy during the march will inevitably cover two or three times the length of road it covered at starting, the escort for this extra length cannot be provided for beforehand, because it depends solely on the number of companies with the convoy. I have every sympathy with Captain Terry in his effort to secure some portion of the combatant command to the A. S. Corps, because if his corps may be denominated the fifth arm, we—the Engineers—are supposed to be the fourth arm, and we used to be terribly sore in the old days, when we were not allowed to be regarded as a combatant arm in any way. In the field the Royal Engineers and Army Service Corps stand with regard to many of their special duties precisely on the same footing. Let me suppose that Captain Terry is in charge of a convoy, and I am in charge of a pontoon train. Our position is exactly the same. He is told to take the convoy; I am told to make the bridge over which it has to go. He and I have both passed the examination in tactics, and why should not we do the fighting work? But my special duty is to make the bridge, and I cannot be in two places at once, and do two things at once. In the same way with the Army Service Corps. Captain Terry is in charge of the convoy, and must be with the convoy, and not away from the convoy. I always told my brother officers when I was teaching them tactics, that they should understand tactics sufficiently so that when executing their technical dnties they should carry them out as far as possible in accordance with tactical requirements. If I am sent with a pontoon train to make a bridge across a river, and if I know nothing of tactics I look at making the bridge only from a technical point of view and say, "I will make the bridge at that point." The officer in command comes and says, "If you make the bridge at that point I cannot protect you; you make it half-a-mile farther off and I can protect you." If I know nothing about tactics I may quarrel with him; but my knowledge of tactics enables me to judge his views and we coöperate together. We sappers have been taught tactics in order that we may put our fortifications and such-like in conformity with the requirements of tactics. In the same way the Army Service Corps officer may elect to park or to march by a particular road. The officer commanding the escort comes up and says: "I cannot protect or defend you if you go by that road, or if you park on that spot." If the Army Service Corps officer understands tactics, there will be coöperation and agreement, and that is the value of the Army Service Corps learning tactics. I am afraid, Captain Terry, I must differ from you, although I sympathize with you very much. When I was your age I kicked terribly against being, as a sapper, regarded as a non-combatant officer. But no doubt there is contentment to be got from the history of the past; and although I daresay I should like our sappers to have been at the Atbara in the fighting line, yet I am content to think that there would have been no Atbara at all if the sappers had not made the railway. It is just in the same way with the Army Service Corps; if they have not the glory of fighting they carry out their work of supplying the fighters, and without their invaluable aid there could be no fighting at all.

Captain TERRY, in reply, said :—I am going very briefly indeed to reply to the remarks which have been made, because I am in a somewhat difficult position. The officers, with one exception, who have been kind enough to criticise my paper, are so immensely my seniors, that I really cannot get up and say that I do not agree with them. It would only make me, perhaps, ridiculous. However, I should like, in reply to Colonel Reeves, to say that as far as I can understand, he starts very much with the same hypothesis as I did, only he came to the conclusion that by the corps being self-defensive it would hamper the general in command. I am very sorry, but I must stick to my opinion that it would help him. I think the more independent his different arms may be in themselves, the lesl he will have to bother about what after all are really details. Then Colones Reeves spoke about the work of the train abroad being, generally speaking, different to what it is at home—which no doubt is absolutely correct. But I specially limited my remarks to the case of a big European war abroad in which, I think, the work will be very much the same as it is at home, because you will have the same kind of country to manœuvre over and very much the same kind of work to do as we have in the big manœuvres here; if not, then the big manœuvres are no use. Colonel Reeves asked what would you do with this number of men, supposing the companies were increased in proportion of two men to a horse. Well, my answer to that question is, that it is only by increasing the companies to such a strength as I suggested that we shall be able to practise what I would like to see the companies do in war. If you do not increase the men you cannot do it. We have not enough spare men, and you cannot tell the few we have to fight. They are all driving. You want the additional spare men to give them a smattering of the training I hold to be necessary. I think Colonel Reeves made a mistake—I say it with all respect—but I understood him to say that we should have many more spare men in war, but that is not the case. The proportion is less—only one in six on a war footing; whereas in peace, even with our present establishment, it is two in three; so that as we go on increasing our men we do not increase the relative number of spare men, but we get fewer spare men although the total is bigger. I say we want more spare men, not less. As regards the reservists, both Colonel Reeves and Lord Methuen spoke up for them. I wish it to be understood that I don't say anything against the reservists as men or soldiers. What I did say was, that when you take the field in a transport company (which has to be split more or less), you want a company that has been thoroughly welded together. I quite admit that at the end of a campaign reservists are as good soldiers as anybody, probably better, because they have been soldiers longer; but when you have a company of only 50 men of all ranks and you increase it to 250 or 300 with reservists, I say it will be a difficult thing to start that company fair and square. You have men who do not know each other, and who do not know you, and may not trust you; or you may not trust them; and until you get to know one another you will find it somewhat difficult to carry on the work. In reply to General Lord Methuen: he instanced India; but as the Army Service Corps does not go there I did not take that country into consideration at all. Of course, I know, if we had to repel, say, a Russian invasion, it might be possible that the Army Service Corps companies would be sent ont to help the Indian transport; but I confess that is rather a remote contingency, and I have not from that point of view considered the subject at all. As regards the carbine, with great respect, I cannot agree that it is a better weapon, and I cannot

agree with Captain Heath, because it seems to me that an enemy armed with a long-range rifle might pick off your men and horses, and if your escort has nothing but a carbine to fire back with it might not reach the enemy at all. You must have a weapon that will be able to reach the enemy ; it does not matter how straight it will shoot up to 600 or 800 yards if the enemy can shoot straight up to 1200. As regards the weight, the two pounds difference would not matter in the least if the rifles were carried as I suggested they should be, on the wagons. If you have it on the horse's back the weight does matter, but if you put it on the wagons and let the animal draw it, it is practically immaterial. In answer to Captain Heath, I have only to say that I have not considered the conditions of defending England, because I am one of those who hold that as long as we have command of the sea invasion is impossible. With regard to your remarks, sir, our little battle has been fought out already on paper, more or less, and, with great respect, I think we have left off agreeing somewhat to differ. There is one thing, however, I should like to say. You talk of a convoy trailing out, which no doubt it does ; but I do not think, under ordinary conditions, that individual companies ought to trail out. The company ought to be able to keep together fairly, and therefore I have taken the company as a unit, and the escort of the company as a unit ; and so you will always have your 100 or 70 men to defend your company. If it trails out, you must split up your escort. I have only argued from the supposition that any enemy that may attack you will consist only of small bodies, who may have either got round or otherwise eluded your covering screen, which I still maintain will be necessary to act at long distances from the convoy. I do not look forward to the time when the convoy will have to repel a general attack, because that will be done by the convoy guard falling back on the convoy, and doing the fighting ; but I do think it is possible that a small body of the enemy may elude that screen, and give you a certain amount of desultory fighting. It is for this purpose that I think the spare men of the Army Service Corps should be trained to take their place in battle more than they are at present. I have to thank you, sir, very much for the honor you have done me in taking the Chair this afternoon, and I have to thank the distinguished officers who have so kindly spoken, and also all those who have listened to my remarks.

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XUM

Military Notes.

A NEW MILITIA SERVICE IN ENGLAND.

A SPECIAL army order has been issued from the War Office providing that, with reference to the provisions of the Reserve Forces and Militia Act, 1898, a new section of militia, to be styled the "special service section," shall be formed from December 1, and that the regulations for the militia shall be amended in accordance with the following rules:

1. The special service section of the militia will be composed (a) of individual militiamen engaging for service abroad with the Regular forces; (b) of militiamen engaging for service abroad with their militia units.

2. A militiaman may only engage for service abroad with the Regular forces if he does not belong to a militia unit registered for service abroad under paragraph 3. If his militia unit should be so registered after he has engaged for service with the Regular forces, he will then cease to be liable for army service in respect of his engagement as a member of the special service section, but will be required to proceed for service with his militia unit when it is sent abroad.

3. A militia unit may be registered as available for service abroad if not less than 75 per cent. of the officers, and not less than a similar proportion of the men, present at the training, make a voluntary offer, certified by the commanding officer, to extend their services to any place out of the United Kingdom under the Reserve Forces and Militia Act, 1898. Preference as to the registration will be given to regiments having two or more militia battalions.

4. Militiamen engaging for the special service section may belong to the artillery or the infantry, and will be required to possess the following qualifications:

(i) They must have at least 12 months unexpired of their current militia engagement, and, if engaging for service with the Regular forces, they must not be less than 20 years of age, and must have served two annual trainings; if for service with their militia unit, they must not be less than 19 years of age, and must have served one annual training.

(ii) They must fulfil the requirements as to height, weight, and chest measurement of recruits for the Regular forces, as laid down in the Recruiting Regulations for the arm of the service to which they belong.

(iii) They must be medically fit for service at home and abroad. Before joining the special service section each man will be examined by a

military medical officer (or the medical officer in charge of his militia unit), and only those who are certified as medically fit for service at home and abroad, and who fulfill the requirements as to age, standard, etc., stated above, will be accepted.

5. The conditions of service of the special service section will be as follows:

Conditions applicable both to men engaging for army service and to those engaging for service abroad with their militia units.

(a) They will be liable to serve for a period not exceeding 12 months in any part of the world (including India), whether an order embodying the militia is in force or not at the time.

(b) They will be released from their engagement in the special service section, and will revert to their ordinary militia engagement, after having served abroad with the Regular forces or with their militia unit.

(c) They will be required to undergo annually a special musketry training for seven days in addition to the ordinary annual training.

(d) They will be allowed to join the Militia Reserve.

(e) Militia Reserve men may join the special service section.

(f) The members of the special service section will be medically examined once a year during the annual training, and those who are found unfit for service abroad will be discharged from the special service action and revert to their ordinary militia engagement.

(g) They will not be permitted to purchase their discharge from the militia while on service abroad or on being called out for service abroad; but discharge by purchase may be granted them, before being called out for such service, on the following conditions:

(i) For discharge from the militia, on payment of £3.

(ii) For discharge from the special service section while continuing to serve as militiamen, on payment of £1 provided they give one months' notice in writing to their commanding officer.

Conditions applicable only to men liable for service with the Regular forces.

(h) They will not be required to proceed abroad unless, in the case of infantry, at least two-line battalions of their corps are either serving abroad or under orders to proceed abroad; and in the case of artillery, unless the numbers of rank and file of the garrison artillery serving abroad are more than double those serving at home.

(i) They will be liable to serve in their own corps only, unless they volunteer to serve in other corps.

(j) Subject to the foregoing conditions (a) and (b), their liability to be called out for army service will last during the period of their current militia engagement.

6. At the end of the annual training the members of the special service section will receive, in addition to their ordinary emoluments as militiamen or Militia Reservists a bounty of £1 in advance for each complete year, and for any balance of not less than six months, of their

liability to service in the special service section. Those who engage for service abroad with the Regular forces will, on being called out on army service, immediately receive, in lieu of such bounty and other emoluments, the full advantages of a soldier of the Regular army of the arm of the service to which they belong, including messing allowance and separation allowance, and if discharged in consequence of wounds, injuries, or disability, received or contracted while on service, they will be entitled to pension in accordance with our warrant for the pay, appointment, promotion, and non-effective pay to our Regular army. On completing their period of army service they will receive a gratuity of £5.

7. A member of the special service section who enters the navy, or enlists and is approved for the Regular forces (including the Royal Marines), if he so enlists before attending a militia training subsequent to that in which he joined the militia special service section, will be required to repay any special service bounty he may have received.—*The Army and Navy Gazette.*

VICKERS' 3-INCH 12½-POUNDER QUICK-FIRING FIELD EQUIPMENT.

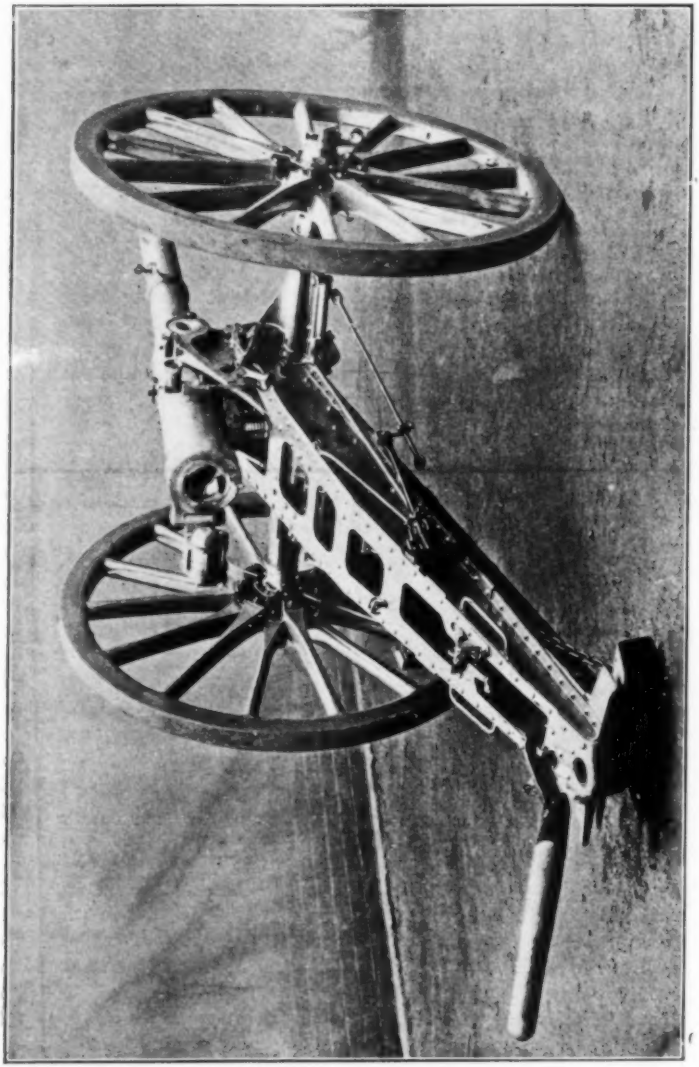
The gun for this equipment is of steel and wire construction, and is 23.5 calibres long, its total length from the breech face to the muzzle is 6 feet 3½ inches; and with a charge of 14 ozs. of cordite and using 2½ lbs. shot, a muzzle velocity of 1600 feet per second and a muzzle energy of 222 foot-tons are obtained.

The gun is also constructed to take a 1-lb. charge, which will give a muzzle velocity of 1720 feet, and a muzzle energy of 256.4 foot-tons.

The breech mechanism is opened or closed by the horizontal movement of a hand-lever, so that the same action rotates, locks, or unlocks the breech plug and swings it around the pivot on which it is mounted. The arrangement consists of a link, one end of which is pivoted on a pin projecting from the rear face of the breech plug, so that the link works in a plane parallel to the breech face of the gun, the other end of the link is pivoted to a short crank which is mounted on the plug carrier, and around the boss of this crank are formed skew gear teeth.

The hand-lever for actuating the breech mechanism is pivoted on the plug carrier and moves on a plane at right angles to the breech face of the gun. Around the boss of this hand-lever is fitted a skew gear wheel, which gears with the skew gear teeth, formed on the boss of the crank.

The whole is arranged and proportioned in such a manner that when the breech is closed the hand-lever lies close up to the breech face of the gun, also the centres of the link and crank are arranged that when the breech is closed the centre lines of the link and crank form a nearly straight line, the pivot joint of the link and crank being a little past the dead centre thus forming a locking point. This arrangement of centres and pivots together with the relative lengths of the link and crank provide great power when opening or closing the breech.



THE NEW VICKERS' 12½-POUNDER Q.F. FIELD-GUN.

On swinging the hand-lever away from the gun when opening the breech, the crank moves the link past the locking centre a short distance without causing any perceptible movement of the plug. The further movement of the hand-lever causes the crank to turn, and by means of

the link rotates the plug at first very slowly (thus obtaining great power) and then more rapidly until it becomes unscrewed, the carrier then moves with the lever swinging the plug clear of the gun.

The firing gear is arranged for firing with the English service friction tube or with the English service percussion tube, and is operated by the link of the mechanism so that at the first movement to unlock the breech plug it becomes impossible to fire the gun.

An extractor is fitted to this firing gear which automatically ejects the empty tubes during the opening of the breech mechanism.

The breech plug is of special construction, and is threaded in segmental portions in steps of varying radii. By this arrangement the plug, which is divided into six segments, has two-thirds of its circumference threaded and useful for meeting the strains on the breech, while the ordinary breech plug has only half its circumference threaded and similarly useful.

This enables the breech plug to be very short.

Owing to the shortness of the breech plug it can be swung clear of the breech after unlocking without any curvature, and without the usual longitudinal withdrawal of the plug, even though the De Bange obturator is used.

The mounting consists mainly of the following parts:

1. The trail.
2. The top carriage.
3. The hydraulic buffer.
4. The wheels and axletree.

The characteristic feature of this carriage consists in the way in which the recoil is taken up. A long recoil is allowed for, viz., about 30 inches, so that there is no sudden jerk or strain thrown on the structure, but the energy of recoil is gradually absorbed by the buffer and spring until the moving parts are brought to a state of rest, then the spring reasserts itself and returns the gun to the firing position.

The system may be briefly described thus:

All parts of the mounting are free to recoil except the hydraulic buffer which is placed between the outside plates of the trail, the front end of the buffer piston is fixed to the front end of the mounting, and to the rear end of the buffer is attached a strong spade, the buffer is further attached to the spade by a chain.

The trail is of special form and length so as to slide freely back, and all "jump" is obviated. On firing, the spade is forced into the ground, thereby arresting all movement of the buffer rearwards, but the trail being free to move to the rear, forces the piston rod into the hydraulic buffer, thereby displacing the liquid, at the same time compressing the powerful spring. After the energy of recoil has been absorbed, the power stored up in the spring serves to run the gun forward in the firing position again.

The gun is connected by trunnion bearings to the top carriage, which

is pivoted to the front part of the trail, so that it can be trained through an arc of 6° (*i. e.*, 3° on either side of the axis of the mounting), thus permitting of small adjustments in laying without any movement of the trail.

If required, the hydraulic buffer can be removed in about one minute, the mounting may then be used as an ordinary field carriage, and the recoil (which is then about 7 feet) is checked by means of ordinary shoe brakes applied to the tires of the wheels.—*Journal Royal U. S. Institution.*

LORD DUNDONALD'S MACHINE-GUN CARRIAGE.

At the Cavalry Field Day Ground, in Windsor Park, a partial trial was recently made of the galloping gun carriage for machine guns invented by Colonel the Earl of Dundonald, commanding the 2d Life Guards. The word "partial" is not used in a carping sense, but simply to indicate the fact that the carriage was not tried over really rough ground, but upon good and smooth turf, and it was necessary, and quite easy, to rely upon Lord Dundonald's statement that it had been submitted with success to tests far more severe in the way of obstacles. Those former trials were of a public character, and were reported upon officially in favorable terms. Ever since the Princess of Wales, at a Wimbledon Meeting many years ago, caused the bullets from a Maxim gun to cut a long target from end to end with bullet-holes, as regular in their sequence as those which divide a check from its counterfoil, I have been profoundly convinced that machine guns of this type, provided that they could be brought into action quickly, were the weapons of the future. The evidence given on this occasion strengthened that conviction, for an officer who had recently been in charge of machine guns on active service announced publicly that it was his experience that at any distance up to 1000 yards the enemy simply could not face them. Bravery in the face of Maxim gun-fire within that distance is of no more practical value than it would be in a crop of standing hay before a mowing machine. Lord Dundonald's efforts have been directed to the purpose of so improving upon the existing cavalry machine-gun carriage that the guns, of which he would allot two to each squadron, may be able to accompany cavalry into action, and may be as rapid in movement as cavalry themselves. Let us consider the ordinary cavalry Maxim gun carriage. It weighs, said Lord Dundonald, 9 cwt., it requires the services of two horses, it cannot be moved from place to place rapidly without horses, it is not detached from its horses with ease, its traverse of fire is only 120° and the method of supplying the gun with ammunition is slow. For his carriage, Lord Dundonald claims that it weighs rather less than 400 lbs., and, besides being drawn easily by a single horse accompanying cavalry at the gallop, that it can be easily moved and fired by one man. This was clearly proved, when two machine guns accompanied a squadron of the 2d Life Guards, who

went away at the trot, advanced at the gallop, and then acted as dismounted cavalry. The machine guns were actually in position, detached from the horses, and firing their rounds before the dismounted men. Then first a stalwart trooper and later a drummer boy ran the gun and carriage about with ease. So much for the mobility of the carriage.

The ease with which it can be detached from the horse and with which any horse from the ranks can be taken to replace one which may be hit are also remarkable points. The horse, in the first place, carries the ordinary cavalry saddle and so forth. In addition, he carries, by means of a breeching, a short pair of shafts (of hickory or lancewood and steel) of which the front ends go into leathern sockets just short of the horse's girths. These shafts are united in the rear, and at the point where they meet is a cup with a certain amount of play in it. The attachment of the carriage to the shafts or its detachment from them are matters of a second's work only. The round steel bar, which is the rearmost part of the carriage, is passed into the cup, and a steel bolt is dropped into the apertures provided. The carriage is then attached. Take out the bolt and the carriage is detached. During the act of firing, the horse is hobbled and cannot get away, so that one man can manage the whole business. Each carriage, still within the weight of 400 lbs., carries 1500 rounds of ammunition in an automatic revolving cartridge carrier. Of such carriers two models were shown, and both seemed satisfactory. Last remains the important question how a carriage of such light weight and possessed of so much endurance and power of surmounting obstacles is constructed in the important details of wheel and axle. The axle is of steel; the wheels are of hickory and steel, with a light steel tire. The latter look very light, but it is believed that their strength is amply sufficient. In fact, the hickory wheels have survived a shock which bent the steel axle. The only fault that has yet been discovered was in the original shafts, when the carriage was tried last year; but those, as Lord Dundonald explained before they had been used, were merely a makeshift, the work of a Windsor blacksmith. For the rest, the carriage has been submitted to all sorts of tests without upsetting. It has been driven with one wheel in the ditch and one on the road, and over piles of boxes without mishap. The secret of the success attained seems to lie in the nice adjustment of sustaining powers to load, in the fact that there is but one point of attachment between the shafts and the carriage, and in the fact that there is some play at that point. An eminently serviceable single-horse ammunition cart was shown at the same time.—*Journal Royal U. S. Institution.*

SUPPRESSION OF THE CORPS ARTILLERY IN FRANCE.

There is a good deal of discussion in France at the present time on the subject of the suppression of the corps artillery, which many advocate, having regard to the step lately taken in Germany, though, as we have remarked, that step cannot be regarded as definitive. The corps

artillery, they say, is cumbrous and lacks mobility in the field ; it causes the general in command to detach a large body of men for its protection ; and, worst of all, it leads him to enter too much into the details of the fighting, whereby the initiative of commanders of divisions is likely to be paralyzed. On the other hand, it is argued by many that it would be dangerous, at a time when the army corps as a fighting unit is more than ever important, to risk a change which would probably affect its cohesion. The possession of corps artillery, say these, enables the general in command to give powerful help to the division at the moment when it makes its greatest effort. Moreover, if it were necessary to attach artillery especially to a division, the general could make such a disposition of forces, while it would be difficult for him, even in the need of massing a large number of guns, to withdraw them from the divisional commands. General Tricoche, himself an artilleryman, argues in the *France Militaire* against any fundamental change, on the ground that the division must always be a subsidiary fighting unit and should not be overweighted. He does not believe that the Germans will make any such mistake. In 1870 they knew perfectly well the extreme advantage of being able to bring large bodies of artillery into line at the beginning of the action, on the initiative of the corps commander and not of his subordinate. France, on the other hand, trusted to her general reserve of artillery to strike the final blows. Large numbers of batteries were thus dragged after the armies, and when the battle was almost lost, and it was decided to put these heavy masses in motion, they generally arrived too late. In this connection General Tricoche recalls the rôle which was imposed upon the fine artillery of the Guard on the day of Saint Privât.

WHO INVENTED THE LEATHER GUNS?

By Lieut.-Colonel H. W. L. Hime, late R. A.

Four claimants to the invention of the Leather Guns have been brought forward at one time or another: Gustavus Adolphus, Colonel James Wemyss, Melchior Freiherr von Wurmbrandt, and Colonel Robert Scott.

The claim made on behalf of the King of Sweden, by the Rev. Dr. Walter Harte, may be at once put aside as baseless. So busy a prince had no time for the construction of pieces of artillery. Clear and convincing proofs would be necessary to establish such a claim, and Dr. Harte has given us no proofs whatever. Two writers whom he quotes give it no real support. Pomo merely speaks of the guns (at Leipsig) as a late invention—"cannone d'invenzione nova &c." ; and Lotich confines himself to an ambiguous assertion—"cujus (the king's) industriâ inventa tormenta bellica, minoris, generis, et ferè portabilia &c." No one will lay the slightest weight on these vague and dubious statements. The king adopted the guns, but he did not invent them.

Colonel Dodge, of the American army, tells us that the king "him-

self contrived " 3 and 4-pr. shortened guns in 1625 ; but as he has cited no authorities (except generally, in his preface), it is impossible to discuss a statement which is apparently due to some oversight or misapprehension. Fryxell, it is true, speaks of these iron guns as "the King's second invention " ; but his meaning is sufficiently plain. He is speaking of the King's adoption of a second invention made about that time. It matters little, however, whether this explanation be correct or not. The highly improbable proposition that Gustavus invented any gun, is not, and cannot be established by the bare assertion of anybody. The invention in question was almost certainly due to Colonel Hans Henrik von Siegeroth, who discovered experimentally, in 1624, that the existing iron field-guns could be considerably shortened without diminishing their shooting power.

The evidence in favor of Colonel Wemyss, Master Gunner of England under Charles I., rests upon the authority of a few writers who took part in the Great Rebellion, and who had no opportunity of verifying their statements. Sir Richard Bulstrode, for example, in speaking of the action at Copredy Bridge in 1644, says that Wemyss was taken prisoner by the Royalists, and with him some guns of his invention. He had had "a good sum of money given him for the invention of making those Leather Cannon." That Wemyss, owing to the office he held, had superintended the manufacture of these guns, is beyond a doubt ; but there is no tittle of proof that he had invented them. In fact, as will be seen when we come to speak of Scott, the evidence we possess makes it quite certain that he did not invent them.

We learn from the Swedish Biographical Lexicon already quoted that, after the outbreak of the Thirty Years' War, Freiherr M. von Wurmbrandt resigned his post at the Court of Vienna from religious scruples ; joined the Swedish army ; and presently invented the leather guns. These statements are fully corroborated by a long series of writers, from Mauvillon a Frenchman who wrote in 1764, down to Captain F. A. Spak, of the Swedish artillery, whose book was published recently. The invention dates from 1627. The first trials of Wurmbrandt's leather guns, says Geijer, were made at the camp of Dirschau (near Dantzig) in September, 1627. Rango, whose work was published about the same time as Geijer's, states that they were first used at the siege of Wormditt, October, 1627,—as an experiment it may be presumed. The experiment was of course most unsatisfactory, as we gather from Dr. Salvius' letter to the Swedish Chancellor, Oxenstjerna, relative to a bullet wound the king had received in the shoulder, dated, Wormditt, 15 October, 1627 :—"depuis quelques jours (le Roi) a été un peu contrarié par de mauvaises nouvelles, et par les canons de petit calibre qu'il a avec lui et qui ne produisent pas d'effet sur les gros murs." Inventors, as a rule, are not wanting in confidence in their own productions ; but great indeed must have been Wurmbrandt's assurance when he adventured his guns before the walls of Wormditt. What makes the

incident all the more surprising is, that their usual projectile was case. They were not equal to the strain of a prolonged discharge of round shot. The value of case, in fact, was first clearly shown after their invention. Case and grape had probably been known since the end of the sixteenth century, but their use was only occasional until the introduction of the leather guns. Whatever the true explanation, Wurmbrandt received a reward from the king for his invention, a large part of which he lost immediately afterwards in a lawsuit brought against him by a clever Dutchman, Louis de Geer, for an infringement of his rights. In 1627 Geer entered into partnership with Mäster Wilhelm Giliusson, an iron-founder, and they obtained a concession from the Swedish Government for the exclusive manufacture of ordnance for six years (from 1627). This privilege was infringed by Wurmbrandt, and he suffered accordingly.

The fact that a reward was given to Wurmbrandt by the King points clearly to two conclusions. First, the King did not invent the guns; secondly, he believed Warmbrandt to have invented them. Weighing this very important fact with the many others previously mentioned, we may take it as quite certain that Freiherr von Wurmbrandt was the inventor of the leather guns the King used in his wars.

The evidence for the fourth claimant has now to be examined.

In St. Mary's Church, Lambeth, there is the following epitaph:—

"Nere to this place lyeth interred the body of Robert Scott, Esq., descended of the ancient Barrons of Bawerie in Scotland. He bent himself to travell and studie much, and amongst many other things he invented the Leather Ordnance and carried to the King of Sweden 200 men, who after two years service for his worth and valour was preferred to the office of Qr.-Mr.-General of His Ma^tie^ Army which he possessed three years: from thence with his favour he went into Denmarke (where he was advanced to the Generall of that King's Artillerie): theire being advised to tender his services to his own Prince, which he doinge His Ma^tie^willinglie accepted and preferred him to be one of ye Gent. of his most honorable Privie Chamber and rewarded him with a pension of £600 per annum: this deserving gentleman * * * surrendered his soule * * * 1631: &c."

"In lapidary inscriptions a man is not on his oath," said Dr. Johnson. Let us verify, so far as we can, the various statements in this epitaph.

We have proof positive that a pension of £600 a year was settled on Scott by Charles I. The "Calendar of State Papers, Domestic Series," 1629–31, shows that "a grant of denization" was made to Col. Robert Scott, his wife and children, and his nephew, James Wemyss (mentioned before as Colonel) on the 20th February, 1630; and on the same date there is another entry:—"Grant of pension of £600 to Col. Robert Scott." Five months previously the King had authorized the Attorney General to purchase Sir George Chute's house in Lambeth, "with a

close of eight acres," for £1400, "the King's purpose being to place therein Col. Robert Scott for His Majestys' Service," *i.e.*, for the proof of ordnance. We have equally conclusive proof that Scott held the rank of "Generalqvartermästare,' and at one time or another commanded a Company of Scots in the Swedish army. But did he invent the leather guns?

It is obvious that if the words "the leather ordnance" in the epitaph are used in their common and familiar sense, as equivalent to "the *Swedish* leather ordnance," either the evidence for Wurmbrandt is a tissue of falsehood, or the epitaph states a gross untruth. We are happily saved from this dilemma by a document deposited in the Swedish Secret Archives, quoted by a Swedish historian, which shows very clearly that the words in question are not used in their usual sense, and that they are an abbreviation of the longer phrase,—"the leather ordnance used in the *English* service when this epitaph was written." In April or May, 1628, as appears from this document, Scott produced a leather gun at Stockholm, the exact construction of which he kept secret. This gun was only half the weight of Wurmbrandt's, and took a charge of one-half the weight of the shot while Wurmbrandt's could only take one-eighth. Other advantages were claimed for it by Scott, and in a letter to the King, 15th November, 1627, Count Jacob de la Gardie said he had seen Scott's gun make better practice than Wurmbrandt's; but it was not adopted in the Swedish service, because Gustavus refused to pay the £1500 asked by Scott for the secret. On this, Scott took his leave with "His Mat^ie^ favour, and went into Denmarke." It is perfectly clear, then, that the phrase "leather ordnance" in the epitaph does not refer to Wurmbrandt's guns, on which doubtless Scott, as a rival inventor, looked with scorn; but to a gun of his own invention, offered to the King for a certain sum, and declined by his Majesty.

Of Scott's visit to Denmark only a few faint traces remain and these few we owe to the sagacity of an officer of Danish Artillery, Captain O. E. Blom. When examining the fragmentary, official, Danish records of the seventeenth century, he fell upon a mention of a "lerstœcker" on the 2d October, 1628, which, speaking "under all reserve," he suggests to be a corruption of "lœderstykker," or leather gun. The epitaph (of which, of course, he knew nothing) completely confirms this brilliant conjecture. Scott was at work. His gun was under trial at Copenhagen in October, 1628; and again in January, 1629, there is an allusion to a leather gun, a "nye invention," a new invention. Scott's gun which was still on its trial, could be described as a new invention in 1629 with far more propriety than Wurmbrandt's, which had been known since 1627; and what Norseman would have applied the English word 'invention' to Wurmbrandt's gun? The "lerstœcker" was no doubt Scott's gun. But he seems to have had no better fortune in Denmark than in Sweden. His gun was not adopted by Christian IV.: had it been, the fact could not have escaped Captain Blom's notice. And just at this

moment Scott was advised to "tender his services to his own Prince, which he doing His Matie willinglie accepted, &c., &c."

As soon as he found an opportunity Scott introduced his gun into the English service, while Sir Alexander Leslie (afterwards first Lord Leven) may have possibly introduced Wurmbrandt's into the Scotch. When Leslie gave up his command in the Swedish army in 1638, in order to return home, Queen Christina gave him 2000 muskets and two field pieces in lieu of pay. Were these the leather guns he used with such triumphant effect at Newburn, near Newcastle-upon-Tyne, in 1640?

Wemyss succeeded to the office held by Scott, and a warrant was issued on the 26th February, 1633, "for carrying such quantity of earth to Mr. Wemyss' garden at Vauxhall as should suffice for making a butt to prove ordnance." But he does not seem to have succeeded to the emoluments of the office. On the 9th July, 1637, he presented a petition to Government in which he expresses his "fear of being cast into prison by his creditors." He reminds them that he has advanced £1100 out of his own pocket, and prays that "he be not in a worse estate than the mackannikest (*sic*) man that serves the King, as he has these seven years without receiving a penny." He was appointed Master-Gunner of England shortly afterwards, and in a report to Government, 10th September, 1638, he "regrets to say that there are few gunners in the kingdom, at this time, who understand the several ranges of ordnance or use of the mortar, which in effect are the special points belonging to a gunner and impossible to attain unto without a great and continued practice." After he had been taken prisoner at Copredy Bridge, Lord Essex wrote to the Parliament urging that he should be speedily exchanged at any cost:—"a man of his abilities is not to be lost." On the restoration Wemyss was re-appointed to his former office; but, notwithstanding his abilities, he was suffered to end his days miserably. Shortly before his death he wrote a letter asking for his "demission" to Charles II., dated 29 November, 1666, which concludes as follows:—

* * * "he" (*i. e.*, Wemyss himself) "hath nothing from your Majestie in this his old age to maintain him with, which forceth him, with your leave and favour, to retire to a private life (how mean soever), where he shall daily pray for your Majestie's long and prosperous raigne. And remain, your Majestie's

most humble bot ruined servant

James Wemyss."

To return to the leather guns:—when we reflect that Wemyss probably wrote, or assisted in writing, his uncle's epitaph, we feel how groundless is Bulstrode's assertion that Wemyss invented the leather guns.

Did his epitaph simply state that Scott invented *a* leather gun, it would be perfectly intelligible and secure from criticism. As it stands, it could hardly be more misleading. By the juxtaposition of the two phrases "the King of Sweden" and "the leather ordnance," as well as by the vagueness of the latter phrase, it *appears* to attribute deliberately

to Scott the invention of the Swedish leather guns, which he himself would have been the first to disclaim. The guns invented by Scott were used, not in the Thirty Years' War by the King of Sweden, but by the Earl of Essex in the Great Rebellion.

The majority of military writers seem to accept substantially the estimate of the leather guns formed by the Emperor Napoleon III.:—"Ces canons * * * n'ont aucune intérêt au point de vue de l'histoire de l'artillerie." I venture to question the soundness of this judgment. In shooting power the leather guns were confessedly inferior to metal ones; but it was only when they appeared in the field that soldiers first realized, however imperfectly, the importance of another attribute of field artillery, mobility. These guns were short-lived, it is true; but when they disappeared their work was done. They had afforded the first faint indications of what might be achieved by a field artillery that could move quickly as well as fire effectively. Owing to the backward state of chemistry and metallurgy, the construction of such a system was impossible in the time of Gustavus Adolphus; and it was not, in fact, accomplished for more than a century after his death. The creation of horse artillery in the eighteenth century by the great King of Prussia was the counterpart of the introduction of the leather guns in the seventeenth century by the yet greater King of Sweden.—*Proceedings of the Royal Artillery Institution.*

THE CYCLE AND MOTOR CAR.

It will be exceedingly interesting to watch the gradual evolution of the cycle and the motor-car as regards their use for military purposes.

In France Captain Gerard, the clever and enthusiastic advocate of the cycle, besides inventing the folding bicycle, has been steadily preaching its virtues, and, with the aid and countenance of the military authorities, practicing what he preaches at successive manœuvres. It was in France, too, that at the great manœuvres this year an invitation was issued to all owners of "automobiles" to lend them for army purposes, and it is probable that in case of war the whole of these useful substitutes for carts and horses would be "requisitioned" for military purposes, to the manifest advantage of the army, and with the result of a great saving of horseflesh.

In Italy the cyclists of the Bersaglieri Corps made experimental journeys from the 15th March to the 15th June and from the 15th September to the 15th October this year, with the view of ascertaining the utility of the cycle and its behavior in rainy weather and under adverse circumstances, together with the effect on the tactical efficiency and fighting power of the men using these means of progression.

Both French and Italian officers reported favorably on the extreme utility of the cycle within certain limits, and say that muddy roads and heavy going appeared to affect the usefulness of the machines and the fighting powers of the riders far less than would be supposed, the latter

arriving at the end of a journey in a given time far less fatigued than if they had marched the same number of hours on foot, while the distances which it was found possible to cover in a day's ride, in spite of heavy rain and muddy roads, or, on the other hand, in spite of heat and thick dust, were surprising to a degree.

It is intended to use motor-cars for the conveyance of non-combatant officers, such as paymasters, chaplains, and others whose duties require them to accompany the march of an army, but who are not accustomed to riding on horseback and whose presence is not required in the field of battle. They will also be used for the transport of the sick and wounded, and of stores of all kinds and perhaps even heavy guns and ammunition for siege purposes; while some advocates of the motor-car have gone as far as to suggest that specially constructed "automobiles" might be used on roads in a manner similar to an armored train on a railway, being provided with shields and carrying quick firing guns or machine-guns on platforms.

Referring to the above propositions, the German authorities seem inclined to favor a policy of *festina lente*, and have carried experiments no further than to use a motor-car for the transport of provisions during the Manœuvres on the Weser. They will doubtless, however, make full use of the invention in every possible way when once they have satisfied themselves as to its practical utility for war purposes.

The Austrians maintain that, judging from experiments made by them on the narrow roads of the mountains in Galicia, the "automobile" is a distinct success, and that it is quite possible to transport mountain guns, with stores appertaining to them, to considerable heights by means of motor-cars, thus doing away with a great number of horses or mules hitherto used as draught or pack animals, though a certain number of these must be retained in any case with the batteries.

Such, at least, was the report which went the round of the military press on the Continent; but one cannot help thinking that either the committee entrusted with the experiments were very sanguine, or the conclusions which they arrived at were wrongly reported. No one who has seen mountain artillery at work, and taken note of the very rough ground and the steep and frequently pathless slopes over which the guns have to be taken, would ever believe in the remote possibility of substituting motor-cars or wheeled transport of any kind for the pack animals at present in use.—*From United Service Magazine.*

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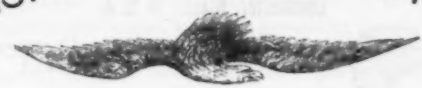

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Reviews and Exchanges.

Stonewall Jackson.*

THERE is always something pleasing about a well printed page. It reminds one of the gentle faces occasionally met with which seem to court acquaintance, and have something pleasant or profitable to say. Such a feeling accompanies the opening of these volumes. Beautiful paper; clear typography; liberal margins. The publisher has certainly done his work well.

A preliminary survey, what might be called a literary reconnaissance, shows that the work is a mixture of Military History from the Southern point of view, and a laudatory biography of a very remarkable man. The language of the author so far as military nomenclature is concerned, is the language of the South. United States troops are designated *Federals* throughout, although the United States ceased to be a Federation when the Constitution was ratified. Then the arguments in justification of secession common in the Confederate States, however fallacious, are copied without comment. For example, the assertion that Virginia repudiated the idea "That a State could be coerced into remaining within the Union" (I. 150) is repeated over and over again, as if the national government had ever attempted that impossibility. That it never did. But when a State had seceded and become foreign territory, it was a fit subject for reconquest.

The statement in the closing sentences of the preface, that loyalty to the State was stronger than loyalty to the Union among the trained soldiers of the Regular army, while generally true, had some brilliant exceptions; and the enlisted men stood by their oaths to a man. There were soldiers in Fort Sumter who had never been out of South Carolina. They had plenty of opportunities to join the forces of their State, and they would have been received with open arms; but they had sworn to serve the United States and they kept their oath.

In our reconnaissance we noticed a foot note explaining the word *House-raising*, and the explanation is erroneous (I. 3). The true meaning is, "a gathering of neighbors to assist in raising the frame of a new house."

To sketch the boyhood of a great man is always difficult. The consciousness that great qualities are hidden in the youngster hampers the sketcher. He is always looking for them. This author has avoided the difficulty. His sketch, while not overloaded with details, or marred with efforts to discover the man in the boy, contains sufficient data for a mental picture of the young man. Earnest in everything his success in life might be called a confirmation of his motto, early adopted, "You can be whatever you resolve to be." (I. 28.)

The author correctly appreciates the value of service on the plains as a training for army officers. Indian warfare may make small demand for strategy and grand tactics; but it calls for all the Spartan virtues, and teaches self-reliance. Officers so trained were invaluable in 1861.

* *Stonewall Jackson and the American Civil War.* By Lieut-Col. G. F. R. Henderson. Longmans, Green and Co.

The description of Scott's campaign in Mexico is clear and concise. Its arrangement is excellent. The events of the campaign pass in review, as it were, everything in place, a perfect military panorama. The author has thoroughly mastered his subject, and he presents it unencumbered by superfluous details and yet lifelike and complete. One feels fascinated as he reads. The closing remarks on the campaign, the army, the Regular soldier and the volunteer, are so wise, so well stated, and so instructive, that we hope the American people will read and try to understand them. Our newspapers so beplaster the events of a campaign with nonsensical rot that the lesson which it teaches is obscured if not altogether hidden from our view. If the American people could only realize the difference between a regiment of trained soldiers, and a regiment of merely uniformed brave men who have learned their drill, they would have learned what every war they have waged has tried in vain to teach them.

"Oh, wad some power the giftie gie us,
To see oursels as ithers see us."

Jackson as a college professor can hardly be called a success. According to our author he was not an apt teacher. He awakened no enthusiasm among the students, and no popularity among the people. He was undoubtedly a good man, a laborious student, and a conscientious deacon of the Presbyterian Church. But he was eccentric and very much misunderstood. He was a born commander, a heroic leader of men, and his neighbors knew it not. This is not at all uncommon. There is nothing so wonderful as human nature. One cannot help wondering if he was conscious of his own powers.

One fact which explains some of his eccentricities seems to have been overlooked by the author. He suffered terribly from dyspepsia while with the 1st Artillery in Florida, and he aggravated the disease by trying to live on a soldier's ration—at that time the most diabolical diet for a dyspeptic in a semi-tropical climate that the ingenuity of Beelzebub could devise. He declared—so the soldiers of his company said—that if it were not for his knowledge of anatomy he could swear that every morsel of food which he swallowed went down his left leg, for he felt it going down. This indicates a very aggravated case, and if he continued to suffer so after leaving the army, many of his eccentricities would be explained.

The discussion of the causes of secession in Chapter IV., Vol. I., is a repetition of the old argument advanced by the secessionists in justification of their action in 1861. They have all been settled by the arbitrament of arms, and might be very properly forgotten. The argument however, that the non-slave holding class could not have been willing defenders of the peculiar institution is new. And it is erroneous. As a matter of fact, the poor whites of the South were more violently pro-slavery than the planters. They were proud of their white skin; they had nothing else to be proud of; and they imagined—perhaps had been taught—that the Yankees proposed to deprive them of a white man's privileges. That they would have had some difficulty in specifying what these were is beside the question. They were not clear thinkers or close reasoners, and a prejudice was more powerful with them than a principle.

The military strength and weakness of the North and South are fairly stated and intelligently discussed in Chapter V., Vol. I. One important factor, however, seems to have been overlooked. The existence in the South of millions of disciplined laborers, does not appear in the equation. Then the insalubrity of the climate for northern men strengthened the southern defense.

These, with the points noted by the author went a long way towards counterbalancing the preponderance of the North in wealth, population, and warlike resources. These must have been apparent to such an earnest military student as Major Jackson. But he said nothing. Indeed his taciturnity was such, that not alone his abilities and attainments, but his very existence were unknown to his countrymen. When he was assigned to command at Harper's Ferry, the question "Who is this Major Jackson?" seems to have been a common one at Richmond. (I. 139.)

The author errs in calling General Patterson "A Regular officer of many years' service." (I. 146, 279.) He was never a Regular officer, although he was a volunteer in Mexico. He was a Major General of Pennsylvania Militia, and entirely unfitted by age for active command. Why he was given an independent command is a mystery, especially so, when such men as George H. Thomas and Fitz John Porter were present in his army.

The blundering which permitted Johnston to join Beauregard unmolested, in time for Bull Run, is well described and agrees strictly with the record. The movement was a walk-over. Patterson made no demonstration, and his excuses cannot be called satisfactory. His blunder lost the Battle of Bull Run.

Jackson's request for 10,000 fresh troops after that battle with which to capture Washington, is better evidence of enthusiasm than of judgment. The retreat of the Union army, though disorderly, was not uncovered. The Regulars were still intact, and the Reserve Division had not fired a shot.

The statement credited to Lord Wolseley, but made by others at an earlier date, that 35,000 Regular troops would have given complete victory to which ever side they fought for is undoubtedly true (I. 207). And yet the American people cannot realize it. They cannot understand that there is any difference between 35,000 trained soldiers and 35,000 brave men who have learned to march and handle their muskets. If the Spanish war would only open their eyes on this point Americans ought to be thankful to Spain.

Occasionally we stumble upon rather startling assertions, so different from Northern experience and temper, that one is compelled to credit them to Southern camp fires. It is deliberately stated that on two separate occasions "It was admitted by the North," that the Southerners were "Within a stone's throw of independence." (I. 208.) One wonders who was authorized to speak for the North in such terms. Whoever did was ignorant of Northern sentiment, or he deliberately lied.

Jackson's winter expedition to Romney, and his wide, not to say wild schemes of winter operations north of the Potomac, were not successful and did not deserve to be. Enthusiasm undoubtedly got away with judgment on that occasion. To be sure his losses in killed and wounded were insignificant; but there were other losses. He had desertions, and he had demoralized a division and disgusted its commander. These results were not likely to facilitate recruitment in that region which was a principal object of the expedition. Still one must admire the daring which undertook such an expedition, and the spirit with which the interference of the Confederate Secretary was resented.

In the Battle of Kernstown General Jackson exhibited qualities, admirable in a brigade or battalion commander, but hardly consistent with the calmness and judgment of a General in-chief. To withdraw an overmatched army is an operation which has to be done occasionally, and to do it handsomely requires calmness. The blind enthusiast, bent on butting his brains out against an over-

whelming force or an impregnable position can never do it. As a strategist Jackson was superior to any of the commanders sent against him. As a tactician his indomitable will and sterling courage induced a recklessness in the face of stubborn opposition, which, if victorious was gloriously so; but if unsuccessful was sure to be disastrous.

The amusement of "Picket Stalking," the description of which is quoted from Colonel Gordon of the Union Army (I. 330) was altogether too common on the Southern side. It is a barbarism indicating the presence of young and inexperienced soldiers, and, if not encouraged in the Confederate armies, was certainly not suppressed. It seems even to have been considered heroic in some commands. The stealthy killing of a solitary sentinel, when not the prelude to an attack or a reconnaissance is a cowardly murder, and has no effect on the duration of the war.

Jackson's manœuvres preparatory to his attack upon Banks, and the operations of his army during the remainder of the Valley Campaign (I. Chap. X) were masterly and characteristic of the man. Well digested plans; impenetrable secrecy as to intentions; restless energy in execution. The description is an excellent specimen of military history, copiously interlarded with anecdotes, quaint sayings of individuals, and speculations as to the thoughts of his adversaries, and the expectations, hopes and fears of the authorities at Washington. This mixture gives the chapter the flavor of a magazine article. It is always well to salt reported conversations with General Jackson, which disclosed his intentions in any way. His conversation with Mr. Boteler, after he had heard of the disaster at Front Royal, and that other with the Presbyterian preacher, (I. 486) call for this kind of treatment.

Jackson's ride to Richmond and his interview with General Lee, at the Council of War are dramatically set forth, and much credit is claimed for the fact that the Union commanders knew nothing of what was going on. Still honors were easy in that regard. The Confederate commanders were equally ignorant of McCleallan's preprations for a change of base, then nearly completed.

The false basis on which numerical strength in battles and minor actions are calculated, has frequently been exposed, but it seems to give Southern writers so much pleasure, that it would be ungenerous perhaps to object to it. The foot note on page 522, Vol. I., copied from Captain Bigelow's work on strategy exhibits the Northern view. In the Uuion armies the tri-monthly reports afford the means of determining exactly the numbers present for duty, sick, etc., in every organization on these particular days, and the number present has generally been taken as the number tactically available for battle. As a matter of fact Union commanders were never able to put more than two-thirds or three-fourths of that number in line. In the Confederate armies there were no such reports, and their "effective" strength was determined by the number of muskets in line. It is doubtful if even the Reserves were counted. The author states that regiments, which, on the books of the Commissary appeared as consumers of 500, or 1000 rations, were reported as carrying into action 250 or 300 bayonets. That is from a half to less than one-third. (I. 313.) Where was the other half or two-thirds? When the question is approached from the side of tactical formations and length of line, some of them certainly seem to have been there, and the pleasant fiction of great inferiority of numbers disappears.

The superiority of the Confederate Service of Security and Information, which is admitted, is easily explained. They operated in their own country, and every man, woman and child was either a scout or a spy. Even the departments at Washington, and the Cabinet, during Buchanan's administration were contaminated by the presence of traitors; and high military officers maintaining confidential relations with President Lincoln, were unfaithful to their duty and their oath. Much is permissible in war, but nations generally draw the line at perjury. Under such conditions, no wonder that the Service of Security and Information was a success.

The description of the Battle of Gaines' Mill agrees with the record and calls for no comment. Porter was admittedly outnumbered and forced to fall back; but he did so slowly, fighting furiously and acting his part in the drama admirably. He fought for delay. The fact that McClellan sent him few reinforcements is attributed to over-cautiousness and the dread of attack from the lines of Richmond. But that is a mistake. While Porter's battle was in progress the movement to the James had already begun. Gaines' Mill was the battle of a rear guard.

It is evident from Lee's dispositions for battle, that he knew nothing of McClellan's projected change of base. And even when the fact was forced upon his attention he could not believe that it was a movement deliberately planned. Perhaps he thought it the consequence of his successful flank operations, and would end in disaster. Such a thought seems to have been generally entertained on the Southern side. The Richmond press ridiculed it, and said McClellan would never reach the James unless he made the trip in his balloon.

It has been asserted that McClellan's march to the James was compulsory—that he was driven into it. But to any one who knows the circumstances under which that march was made that assertion seems an absurdity. To any one who knows the character of the country to be traversed; the magnitude of the train and the amount of impedimenta that had to be transferred; the fact that he had a large force on his flank to stand off during the movement, not to mention the army in close contact with his rear; and, furthermore, that the marching had to be done at night over a labyrinth of mud roads so intricate as to puzzle travellers by daylight; and that the transfer was made in spite of active opposition. The idea that there had been no preparation for it must be abandoned. After studying McClellan's change of base it requires some effort to resist the inclination to recast his character as a commander.

Without questioning the Confederate general's diagnosis of McClellan's mental condition, his march to Harrison's Landing cannot be considered a retreat. He had planned the transfer of his army to Harrison's Landing before the seven days' fighting began. His adversary had done his best to prevent the transfer. The Battle of Malvern Hill was the final act in his failure to do so; and McClellan's march to Harrison's Landing was the accomplishment of his purpose. Whatever might have been the mental condition of McClellan, his army was not demoralized. It was worn out by seven days and nights of excessive exertion, but its *morale* was unshaken.

Jackson's actions on several occasions during the seven days' battle before Richmond, and especially at the crossing of White Oak Swamp, are open to criticism, and were criticised at the time, even by his own staff officers. Of course the author defends his hero, but there are features in the case apparently indefensible. Jackson dropped in upon his critics unexpectedly, and

overheard some of their remarks. We may guess what these remarks were from Jackson's answer: "If General Lee had wanted me he could have sent for me." (II. 71.) There is a flavor of vinegar in that reply. Jackson had come to the crossing of White Oak Swamp with definite instructions. He found them impossible of execution, and he should have reported that fact to his commander immediately. Instead of doing so he indulged in some ineffective cannonading for a purpose legitimate enough, no doubt, but calculated to deceive General Lee as well as his Union adversary. General Lee was with Longstreet, and that cannonading must have been evidence to him that Jackson was at work forcing the passage of White Oak Swamp. Under such a belief, the last thing he could have been driven to do would have been to order Jackson to abandon the attack and march to Longstreet's assistance, or even to ask him to detach troops for that purpose. Jackson's study of Napoleon had induced a belief, unconscious perhaps, but real, that a Commander-in-chief knew everything about his own army, and would resent unsolicited information.

General Pope comes to the front in the XVth chapter, introduced with the usual ridicule, although this author admits that, "with all his peculiar characteristics, Pope was no despicable foe." (II. 101.) The Battle of Cedar Run is claimed as a Confederate victory, and in a certain sense it was so. Still, Jackson failed in accomplishing his purpose, and finally withdrew. He had, at the most, only beaten Pope's advance guard, but he is given credit for having, with an army of 24,000, advanced to the attack of an army of 47,000. (II. 126.) Of course the fact that that army was very much scattered, and, it was hoped, could not be concentrated until Jackson's purpose was accomplished, receives no consideration. But the hope was blasted. Concentration was effected, and the attack was abandoned. Of course the abandonment was good tactics; but what becomes of the daring?

Pope's campaign in Virginia is difficult to follow, even in this author's clear description. The thread of his narrative naturally follows the movements of Confederates, and is clear and explicit enough; but Pope's movements seem to baffle description. Manifestly he was badly served. His cavalry were of little use to him. Until nearly the close of the campaign he never knew positively where his enemy was, and his movements were blind and erratic in consequence.

But there are features about Pope's campaign which ignorance of his adversary's movements hardly explain, and the question suggests itself. Did he have a free hand in the campaign? His letters to Halleck of Sept. 30th, Oct. 30th and Nov. 20th, 1862, might be construed to mean that Halleck was the real commander. Then the telegraph line with army headquarters was reserved exclusively for Pope and Halleck's use. In his answer to a question on the Fitz John Porter trial Pope said, "I stated to him (Porter) that I had, many days previously, received positive orders from General Halleck, to allow no dispatches of any description to pass over the telegraph line except official dispatches signed by myself." That Halleck had a *penchant* for commanding by telegraph is well known, and the language of Pope's letters, the telegraph monopoly, and other incidents, indicate that he may have undertaken it, in some measure at least, during this campaign.

The invasion of Maryland was the natural consequence of Pope's defeat; but doubts might be honestly entertained as to the wisdom of the undertaking. Pope's army had been driven behind Bull Run but it was not demoralized.

There was want of harmony between portions of the Army of the Potomac and the Army of Virginia, but an invasion of Maryland would certainly heal all discords and Lee was not prepared for determined work. Perhaps a rising in Maryland was expected; but with such an army as was then encamped about Washington such a rising was unlikely, and in spite of poor generalship on the Union side, the invaders were apt to be crowded out.

There is nothing in the description of the Antietam campaign calling for comment. The fighting was creditable on both sides, and the "Butcher's Bill" immense. The Union tactics were very defective and hardly deserved success. Nevertheless the fact remains, although overlooked by the author, that the Confederate invasion of Maryland was a failure. Even the people of that much bepitied State seemed to have an instinctive feeling that the cause of the Confederates was doomed. The spirit that prompted an attack on national troops as they marched through Baltimore had died out and Maryland gave no evidence that she was "My Maryland" any longer.

And, indeed, the fact that the rebellion was on the wane could hardly be concealed. The manhood of the South was in arms; but where were they? Not a Confederate army east or west but complained of depleted ranks; and every battle was fought with fatally inferior numbers. Of course, an army on the defensive, fighting on its own territory, can put a greater percentage of its men "present" on the fighting line than the invader can. It has no lines of communication to defend; no railroads to guard; and little scouting to do. But all these advantages disappeared when the Confederates crossed the Potomac, and the Marylanders failed to flock to their standards. To recross the Potomac would have been wise under any circumstances: the battle of Antietam made it a necessity.

The eulogies of McClellan as "The general who had saved the Union at Sharpsburg," (II. 368) comes upon one as a surprise, and he is tempted to turn back and read over again the statements about his incapacity, timidity and overcautiousness. "Little Mac" was manifestly popular in both armies; in the Union army because of his lovable disposition, and in the Confederate army for other reasons. Burnside, his successor, was less popular, and certainly not superior as a commander. The loss of Porter too, was severely felt by the 5th Corps, which he may be said to have created. There was genuine sadness in the Army of the Potomac when these officers left; but to the eternal credit of that army no disloyal word. They seemed to say, we are not here to follow any particular leader, however much we may love him; but to reconquer the seceded States. Lead on!

Burnside cannot be called a great general. He was hardly a respectable Kriegsspieler; and he knew it. In spite of his protest he was ordered to command the Army of the Potomac, and discipline demanded obedience. He was unlucky in almost everything he undertook. He failed through no fault of his own, to occupy the right bank of the Rappahannock on his arrival at Falmouth; he failed in the battle; and he failed in his Mud March. But he cheerfully shouldered all the responsibility, except the mud march failure, and retired from the command of the Potomac Army gracefully enough. He had failed, but he was not surprised at it. He expected to fail.

The fighting at Fredericksburg is described with the author's usual clearness and vigor; especially that which occurred in front of Jackson's corps. Jackson was himself again in that battle, and one cannot help admiring his daring

if reckless proposition for a night attack. The proposition was disapproved by General Lee. That sagacious commander saw that "the attack would be too hazardous." (II. 399.) One cannot help wondering what the result of such an attack would have been.

"The officer or orderly carrying dispatches," who "strayed within the Confederate outposts," (II. 400) thus betraying to the enemy Burnside's intention of renewing his attack in the morning, is rather a suspicious character. Burnside's army would have liked to be attacked. Perhaps somebody imagined that if the Confederates knew of such an attack as the captured dispatch indicated, they would anticipate it at daybreak. At any rate the Army of the Potomac was in line at daybreak, but failed to advance. It withdrew that night to the left bank of the river.

The tribute of praise to President Lincoln is gracefully given; Lincoln was the Union incarnate. He was no accident. He had been led from the log cabin of his birth to the chair of state by no human hand. He had a mission from the Ruler of the Universe, and he was thoroughly equipped for the work. Misunderstood in the South, maligned and misrepresented by their newspaper press, it is not surprising that Lee and Jackson failed to recognize his powers. He never was an aggressive abolitionist, although always opposed to the extension of slavery. When he came into power northern sentiment was divided on the subject. The abolitionists were only a noisy faction. But as the war progressed sentiment began to change and after Antietam the people were prepared for the Emancipation Proclamation as a war necessity. A blunderer would have fired that shot prematurely. Lincoln had the wisdom to wait.

The merits and demerits of Confederate and Union soldiers are discussed at length and with commendable impartiality; success, which generally perched upon the Southern banners during the first two years of the war, was, the author says, to be attributed to the superiority of Lee and Jackson as commanders. This will not be universally accepted. There were other reasons. And the superiority claimed lacked some essential features. If they won victories they never were able to gather the fruits. No army was utterly destroyed by either of them during the two years, and a defeated army ought to be destroyed. Manifestly there was something wanting, either with the victories or the generals in command.

That the Army of the Potomac was poorly commanded during the period covered by the work under review will be generally admitted. As a matter of fact it was too big for Kriegsspieler's management. McClellan's capacity was about 30,000 men. All that he commanded over that figure were merely spectators in battle. Indeed, capable commanders of 100,000 men and over, are very rare. It was some time before such commanders turned up on the Union side, but they did turn up in the long run. and then the tide turned.

In view of the privations to which the Southern soldiers were subjected, it is somewhat surprising that the author has nothing to say about the Supply Departments. During the first two years there should have been no lack of wholesome food in the armies of the Confederacy, and with an army of producers, such as existed in the South, there should have been no scarcity at any time. The officers of the Supply Departments were to blame. In the matter of supply the Union armies were immensely superior to the Confederate, and much of that superiority was due to the officers of the Supply Departments.

The character of Jackson is difficult to sketch. The author's efforts in that

direction are not entirely satisfactory. They give us no clear picture of the many sided man. Tender hearted as an innocent child; stern and merciless as a blood thirsty tyrant. Religious to the verge of fanaticism; Calvinistic to the boundaries of fatalism. He could play with a child almost as a child, and order the execution of a soldier illegally condemned, if the truth is told in the text, at almost the same moment. Drum-head courts-martial had no legal existence in the Confederate army, and the death penalty for words spoken that were neither mutinous nor treasonable is unknown to the code. But we would rather believe that the writers from which this author quotes exaggerated. Then, in spite of his religious belief and familiarity with Bible history, he seemed to think that the Ruler of the Universe had fallen asleep or something, and the cruel North had seized the opportunity to scourge his beloved Virginia. That Virginia was being punished for her misdeeds never occurred to him. He forgot that the Eternal Laws of Right and Wrong enforced themselves; that nations have no hereafter but are punished here; that punishment is never an accident but always deserved; and that the North as well as the South had sinned, and hundreds of thousands of men had to be sacrificed in consequence. All that should have been apparent to a man of his religious belief, and it was not. He was an extraordinary man, and wonderfully prepared for the rôle he was appointed to play. Like Abraham Lincoln, he was no accident. He wielded the Sword of the Lord as certainly as Gideon did.

Military government is despotism, and Jackson was a despot—stern and merciless; just and righteous, if you please, but a despot. Such a commander would be loved by many, hated by some, and feared by all. Such a commander would demand the possibilities and generally get them. Such a commander would sometimes be offensive to his subordinates. Such a commander would conceive impracticabilities, attributing the enthusiasm of his own heart to those of his subordinates. Enthusiasm and discretion were badly balanced in his character. As the leader of a victorious army he would be unsurpassed. As the leader of a defeated one he would be a failure.

The Battle of Chancellorsville need not detain us. The death of Jackson was such as he would have wished, if the bullets had come from his enemies. In spite of his peculiarities he was a great man, a heroic soldier, and an able commander of men.

JAMES CHESTER,
Major of Art'y. Retired.

Bayonet Exercise. *

This pamphlet of 37 pages printed matter and 35 pages of illustrations was recommended for publication by General Butterfield in a letter to its author.

General Butterfield says: "It seems to me that you ought to publish this for the benefit of the new armies called into the field. The knowledge and use would be of great benefit now, as I remember its thrusts, parries, and movements were especially adapted for field work against Spanish machetes, and modern attacks when ammunition gets exhausted, as sometimes it does."

Upon a cursory examination of the pamphlet, the first most noticeable feature is the use of the terms carte, tierce, seconde, prime, passade, etc., etc., instead of the simpler English terms used in the Drill Regulations.

**Bayonet Exercise.* By Paul A. Oliver, late Brevet Brig. Gen'l, U. S. V. and A. D. C. Headquarters Staff Army Potomac.

The subject of Bayonet Exercise is well treated and shows a thorough understanding by the author, of the true principles underlying the art; his work is a very commendable one but it is believed that the use of English words in the commands would increase its desirability for use of troops using that language, and this is particularly true in reference to volunteers whose terms of service will usually be short. McA.